Agricultural
Mechanisation

WORLD CROPS

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The International Journal of Agriculture

VOLUME 11, No. 10 OCTOBER 1959

A Publication of The Leonard Hill Technical Group

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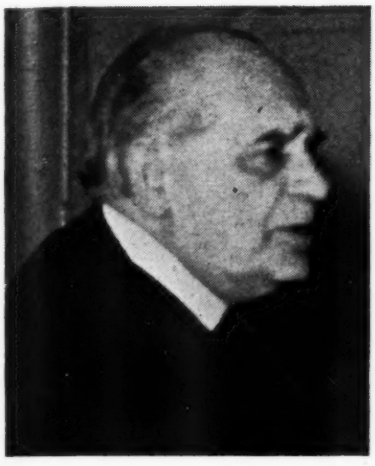
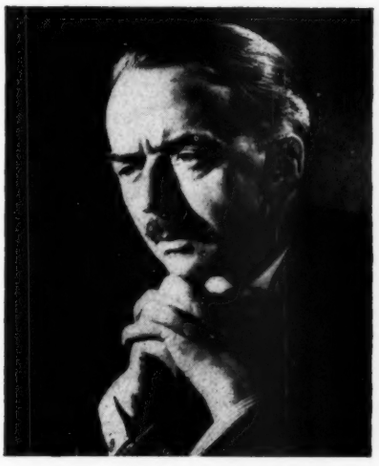
World Crops' First Decade



The late Sir Harold Tempany, C.M.G., D.Sc., F.R.I.C., Founder-Editor of WORLD CROPS, 1949-55

Mr. W. Leonard Hill, Chairman of the Leonard Hill Technical Group and Founder of WORLD CROPS



TEN YEARS – only ten years – but what extraordinary changes those few years have produced. The silent and bloodless revolution of the 20th century was the growing acceptance of new machines and new methods by farmers the world over after centuries of stagnation. Out of sheer necessity, due to the pressing need for greater productivity, the demand for cheap food and the movement of agricultural labour into the manufacturing industries, they have been forced to consider and have not been slow to adopt revolutionary new ideas.

The increasing productivity of existing areas, the bringing into production of new lands and the reclamation of ' badlands ' requires the ready acceptance of the new ideas which the world's agricultural engineers and scientists are producing faster than the world can assimilate them. In this world revolution WORLD CROPS has played its part in giving prompt, world-wide publicity to new inventions, new machines and new materials through its regular features, ' Machinery and Equipment ' and 'Agricultural Chemicals ', and in its original articles by leading authorities on a wide variety of subjects.

Farmers in Britain and planters in remote Assam; colonisation officers in India and Ceylon, and development officers in Kenya and the Federation of the West Indies; forestry personnel in Burma and East Africa and cereal producers in the wide open spaces of Australia, Canada and the U.S.A.; research workers and forestry and agricultural officers in the five continents – all have benefited from becoming regular readers of WORLD CROPS.

Seeds of Success

YET WORLD CROPS was not started primarily as an agent of a coming world agricultural revolution. It began as a result of a quiet conversation between two farmers – one also a publisher and the other an advertising agent. They were commenting on the absence of an international journal covering the business of the wholesale seedsman, about which little was known, because they were so few in number and they indulged in no publicity.

But obviously the scope had to be wider if the new paper was to be a success, so Leonard Hill and his friend, Bertram Ward, considered the idea of a journal for the working farmer and the scientific agriculturist which would interpret the results of agricultural research and introduce new machines and new materials to them and also to specialist research workers in related fields. Intense specialisation, which is one of the secrets of success in research, can have dangerous consequences, and one of the important functions of the new journal would be to provide a liaison between the various branches of the ever-widening field of agricultural science.

What's in a Name?

THE NAME of the new journal had still to be decided. This was not at all an easy matter, as there were already a host of scientific journals dealing with practical agriculture and agricultural research in the specialist sense. None of these, however, were journals of the type under consideration, for they had not the scope and the practical appeal, or else they did not have a world coverage.

Finally was born the idea that, as the paper was to deal with the production of crops the world over, the ideal title would be WORLD CROPS. To Bertram Ward, a partner in the Technical Advertising Service, goes the credit for this happy inspiration.

The idea of such a journal was indeed warmly

received by many knowledgeable and famous scientists and the former Director of Rothamsted Research Station, Sir E. John Russell – probably the greatest agricultural scientist of his day and an acknowledged leader in the Silent Revolution – wrote the foreword on the first page of the first issue of WORLD CROPS. In his wisdom he recommended Geoffrey Blackman, now Professor of Agriculture at Oxford and a Fellow of the Royal Society, to be a consultant to the new journal. About this time Leonard Hill, a past Chairman of the Agriculture Group of the Society of Chemical Industry, met a member of the Society – the late Sir Harold Tempany, C.M.G., C.B.E., D.SC., F.R.I.C. – who had recently retired from the position of Agricultural Adviser to the Colonial Office, and was delighted to find that he was willing to undertake the momentous task of being its first editor.

We – that is, all concerned with the production of this journal – naturally wish ourselves ' Many Happy Returns ' and hope that all our many readers and well-wishers will contribute to our continued success by inducing their friends and colleagues to read it, thus spreading the gospel of scientific agriculture and the doctrine of Peace with Plenty.

From the DIRECTOR-GENERAL OF THE FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

'I wish this journal an increasingly fruitful and prosperous future'

★

Greetings from F.A.O.

★

It gives me much pleasure to extend my greetings and felicitations to the publishers and readers of WORLD CROPS *on the occasion of its tenth anniversary. For a whole decade this journal has rendered much useful service to the farming communities in many countries by bringing up-to-date knowledge and information regarding the technical and economic aspects of agriculture to their notice. This was also the period when vital changes have taken place in agricultural techniques and rural economy and institutions.* WORLD CROPS *has attempted to reflect these changes objectively and has thus kept its readers informed of the problems that beset the farmer and how he can be helped to overcome them. We in FAO attach great importance to the educational value of all such efforts which contribute to a wider understanding of agricultural methods and thus to an increase in the world's production of food.*

I wish this journal an increasingly fruitful and prosperous future.

B. R. SEN,

Director-General, Food and Agriculture Organisation of the United Nations.

Shri B. R. SEN, C.I.E., I.C.S., held many important positions in India before being appointed her Ambassador to Italy and Yugoslavia, 1950–51, and to the U.S.A., 1951–52. He was elected Director-General of FAO at the Third Special Session of that organisation in 1956. He is best remembered for his great work in the relief of famine when he was Director-General of Food to the Government of India during the difficult period 1943–46.

From the MINISTER OF AGRICULTURE, FISHERIES AND FOOD

'World Crops is helping to spread knowledge of new discoveries and better methods'

By the time these words appear I shall have visited in little more than a twelvemonth Holland, Denmark, Yugoslavia, Australia and New Zealand. One of my Parliamentary Secretaries has been to Canada and officials of my Department have visited many other countries. The Director-General of the Food and Agriculture Organisaton of the United Nations has been a visitor to the United Kingdom and we have been visited by the Agricultural Ministers of several oversea and Commonwealth countries.

During this summer we have had in the United Kingdom an International Dairy Congress and a Commonwealth Fruit Farmers Conference. An International Conference on Agricultural Aviation took place in September.

What does all this coming and going and meeting of agriculturists mean, apart from good business for the airlines? Surely that those of us who are concerned with farming all over the world are realising that we have much to learn from one another and much to discuss; in short, that we cannot get on without one another.

In a world frequently described as divided by fear and mistrust, this is encouraging news, especially for the United Kingdom, for Britain's future depends on maintaining friendly relations with countries within and without the Commonwealth in all parts of the world. To us, a trading nation, the world's crops are vital. We depend on them not only for about half the food we eat, but also for the raw material used by many of our industries.

To a country earning its living by manufacture and trade, it is important that its customers should prosper. We cannot sell our products to countries which have nothing to offer in exchange. We therefore welcome any expansion of their purcashing power, particularly in underdeveloped countries.

To this process of expansion the efficient production of food and raw materials is basic. Unfortunately, any increase in productivity must wait on the acceptance by the producers of the new ideas which scientists and technicians everywhere are producing faster than the world can assimilate them. It is here that WORLD CROPS *is helping to spread knowledge of new discoveries and better methods. It is helping to distribute to mankind the gifts of science and technology.*

My greetings to readers of WORLD CROPS *and my best wishes to it for its second decade of useful work.*

JOHN HARE,

Minister of Agriculture, Fisheries and Food.

The Rt. Hon. John Hugh Hare, P.C., O.B.E., was M.P. for the Woodbridge-Sudbury Division of Suffolk until the dissolution of Parliament in September 1959. He was successively Minister of State for Colonial Affairs, Secretary of State for War and Minister of Agriculture, Fisheries and Food.

Editorial Comment

Crossing the Theory Barrier

LAND USE, land utilisation and land capability are terms which merit closer study of their implications in view of the frequent use made of them in agricultural literature. *Land utilisation* mainly involves the current use of land and is strongly conditioned by current economic factors. It is this feature only which is involved in many land-use surveys as presently conducted, and which merely serves as an inventory of cropping practices at the time of observation.

The problem of increasing the world's food supply to meet the increasing demand from rapidly increasing populations, however, emphasises the urgency to move from the level of mere inventory compilation to that of increasing agricultural output. For this purpose we require to know how far we can improve present land utilisation in order that we may approach the potential productive maximum of our land. This is called *land capability*. An assessment of land capability by a skilled and experienced assessor is a highly desirable factor in wise agricultural planning, for it provides a grasp of the maximum productivity of which the land is capable after allowing for the effect of those limiting factors to crop growth which are essentially operative at the growing site.

This approach to land planning provides the practical means of implementing some of the fundamental findings of the pure soil survey. According to the article in this issue, this approach enables the land planner to cross the theory-practice barrier in the complex and comprehensive question of sound *land use*. It further describes how these principles have been successfully implemented in the Soil and Land-Use Survey of the British Caribbean currently undertaken by the Regional Research Centre of the Imperial College of Tropical Agriculture, Trinidad.

The Mechanical Age

AT THE beginning of the 19th century the age of the agricultural machine had hardly begun and steam-powered machinery only came into general use in England about 1850. Steam-cable ploughing was established, followed by the use of the steam cultivator, the mole plough and the thresher.

In the U.S.A. the self-propelled steam traction engine eventually appeared on farms about 1880 and ousted the stationary or wagon-mounted steam engines then in popular use. These mobile steam engines were cumbersome and weighed up to 18 tons each, but they provided much-needed power for opening up farms in the ' wide open spaces ' of the U.S.A.

The advent of the oil-fired tractor was timely, for during the period 1850–1950 the world population doubled and reached 2,000 million, and it is expected that by the end of the century, *i.e.* A.D. 2000, it may reach 5,500 million. Rising food requirements, together with increasing labour shortages due to the development of manufacturing industries, has spurred on tractor production, not only in the U.S.A., but in many European countries, where large manufacturing plants have grown up.

World Tractor Population

A TRACTOR can be regarded as the power-generating source for all types of farm machinery. It has been estimated that one power-assisted land worker produced food for 16 people, whereas his 19th-century counterpart produced for eight.

Today the number of farm tractors at work in the world approaches 10 million and the bulk of these are located in North America and in Europe. The tractor-inspired mechanical revolution of agriculture is now gradually moving into the under-developed regions.

In India the introduction of Government tractor stations has brought increased prosperity to surrounding farms. The tea-rich hillsides of Assam and Ceylon are being cultivated and harvested with mechanical aids. Specially designed slope-compensating tractors are being developed to bring mountainous areas, formerly considered suitable only for grazing, into cultivation. A recently designed supercharger will enable tractors to work efficiently at heights of between 6,000 and 10,000 ft. so that high-altitude land, untouched or barely cultivated, can be brought under the plough.

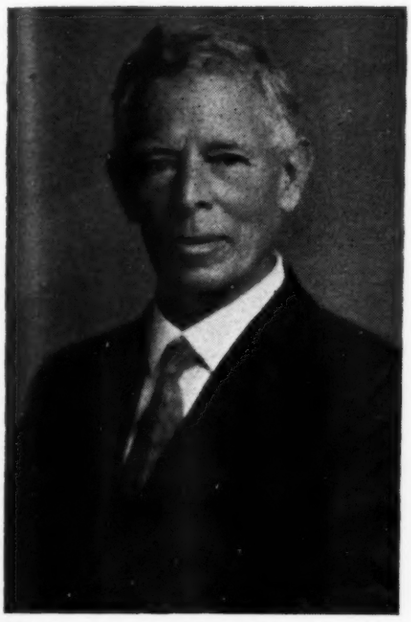
More Land for Food

WHERE THE tractor replaces the ox, the camel and the horse, it also releases land for food crops. During the last 50 years the total of work animals on U.S. farms has decreased by some 12 million, thus freeing more than 50 million acres of arable land previously devoted to fodder. In Britain the number of working horses on farms has decreased from over 724,000 in 1939 to around 147,000 by 1957.

Another task for the tractor is land clearance and rehabilitation. Jungle areas and overgrown plantations of Malaya are being converted into areas for replanting by tractors, which also carry out contour ridging and hauling. ' Water Buffaloes ' – specially designed crawler tractors – are used to tow drainage ploughs, levelling equipment and drain cutters over swampland which could not support the weight of a man. They have reclaimed millions of acres of waterlogged low-lying land in Europe, Asia and Africa.

Looking Forward

SIR E. JOHN RUSSELL, F.R.S.



Sir E. John Russell, F.R.S., in 1929, when he was head of Rothamsted Research Station

'Where lies the land to which the ship would go?
Far, far ahead, is all her seamen know'.
Arthur Hugh Clough, 1819–61

Ten years ago the author of this article wrote on page one of the very first issue of WORLD CROPS*: 'This new journal appears appropriately at a time when a great revolution is taking place in world agriculture'. In the present article he expands this theme and takes a peep into the future.*

IT seems only the other day that WORLD CROPS started its career, one of the numerous products of Mr. Leonard Hill's fertile brain. He was fortunate in securing the services as Editor of Sir Harold Tempany, one of the foremost experts of the day on tropical agriculture; there were many friends and well-wishers of the enterprise and the subject was so well covered that the journal was, from the outset, world-wide in its scope, fully living up to its title.

It has served the useful purpose of keeping busy overseas agriculturists informed about methods found successful elsewhere, and therefore worth thinking about in relation to their own work. It has also informed suppliers and manufacturers of the kind of operations that have to be done for the improvement of crop production in the different regions of the world, thus giving them the opportunity for devising better appliances which on the advertisement pages can be described and pictured to prospective clients. The continued success of the journal shows how great was the need, and how well WORLD CROPS has supplied it.

Age of change

These have been 10 years of great change; perhaps the greatest, though not the most obvious, has been the tremendous growth of science. Old-established research stations have been extended and many new ones established. Papers on various branches of agricultural science have become so numerous that no one person can possibly read them all, nor could he understand more than a fraction of them, even if he tried. How much of the new science will fit into practice it is impossible to say: a distinguished engineering expert has calculated that it takes, on an average, about 60 years for discoveries in engineering science to be commonly adopted in practice. New ideas in the sciences of cytology and genetics have already proved fruitful in the production of new varieties of plants.

Although the agricultural sciences cannot claim such dramatic advances as those made by the nuclear physicists, a great deal of valuable work has been quietly done by the use of the new research appliances now available: spectrometers, electronic microscopes and others. Among them has been further knowledge of the nature of viruses, some of the most astonishing entities in this astonishing world of ours: they are self-reproducing, yet not living. Fig. 1 shows one of them; the particles are so small that only an electronic microscope can reveal them. Viruses cannot yet be controlled, but there is always hope.

Agricultural chemicals

During these last 10 years chemists have made many new and potent agents for controlling pests and diseases of plants and animals and for destroying weeds, and these have been promptly taken up by farmers and growers at home and abroad; millions of acres are now sprayed annually. Vigorous search is made in industrial research laboratories for better agents, while the modes of action are studied by teams working with Prof. R. L. Wain at Wye College and Prof. G. E. Blackman at Oxford. Dr. Woodford, of Oxford, summarised the present position regarding herbicides at the last Weed Control Conference (*vide* WORLD CROPS, 1959, **11**, 66).

This chemical control of weeds will, of course, reduce the need for cultivations. Chemists may still further reduce this need by developing soil conditioners, which, applied like fertilisers, produce a tilth on unkindly soils; some have already been manufactured and may well become practicable for farmers before long.

Chemists and plant physiologists between them have, in the same period, discovered a deal more about the chemical substances made in the plant for regulating root development, flowering, fruiting and many other activities. These substances are used

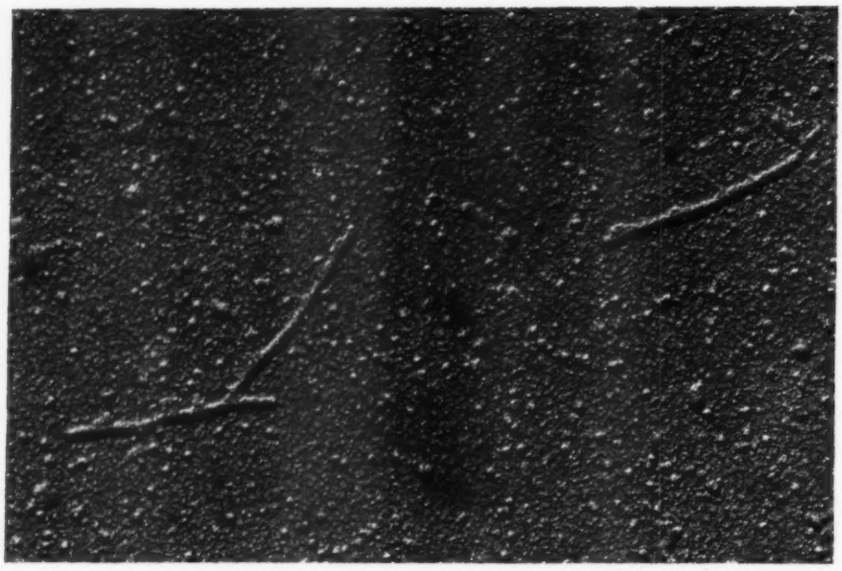


Fig. 1. A remarkable photograph of the potato virus. Magnification: × 55,000

increasingly in intensive production.

The mechanism of animal life is similarly controlled by chemical substances, some of which are now made artificially and used in practice. A synthetic female sex hormone, hexoestrol, is used in this country either mixed in the food or inserted under the skin, usually in the ear, to direct food from the formation of fat to the production of lean meat – also of water and bone.

Of course, all this sort of thing is an interference with nature, but so are many other farm operations. Perhaps the greatest interference is with the reproduction of animals. Pregnant mare serum hormone (PMS) subcutaneously injected four days before the expected heat, or 12 days after the last one, increases the number of ova that ripen at heat.

Artificial insemination has, of course, long been used for multiplying the progeny of sires. It was first done in Russia about 60 years ago; it was developed in Denmark and is now so widely adopted that the bull looks like becoming a rare animal, seen only at a few selected veterinary centres and in zoological gardens. One famous American bull belonging to Rockefeller Prentice is credited with 118,000 calves; obviously at this rate no large numbers of bulls will be needed to keep up our herds.

This decade, too, has seen the beginning of the companion process: the multiplication of offspring from the female. In natural conditions a cow may produce during her lifetime about a dozen calves. But she has the possibility of producing very many more. She is born possessed of 1,200–1,500 ova; each of these when fertilized by the male may become a calf. If the fertilized ova are removed and transferred to other cows, one to each, for incubation and nurture, the young animals finally emerging will be exactly the same as if they had remained in the womb of their true mother; the incubator mother does not impose upon them any of her own characters.

The experiment has already been done with rabbits and sheep; it is only a matter of time before the difficulty of transferring an ovum from one cow to another is overcome. Some imaginative American writers foresee the time when farmers can buy packets of these fertilized ova, insert them into a lot of scrub cows and in one year obtain a herd of the finest cattle. Not to be beaten we might look to the day when a mechanical incubator and automatic feeder will replace the scrub cow, making it entirely redundant.

Agricultural mechanisation

Farm machinery has developed enormously during the past 10 years, resulting in a dramatic fall in the number of horses on the farms of England and Wales: in 1950 there had been 289,000; by 1958 three-quarters of these had disappeared and only 73,000 were left. The number of tractors, on the other hand, nearly doubled during this period, rising from 204,080 in 1948 to 379,350 (10 h.p. and over) in 1958; about half the present tractors and all the new ones have diesel engines. Tractor-mounted hydraulic loaders came in during this period: in 1948 there were none; in 1958, 51,160. So the tale goes on. The most dramatic increases have been in pick-up balers, which in the 10 years rose from 1,820 to 51,620; combine harvester threshers increased from 4,970 to 39,890.

Mr. S. J. Wright, our leading expert on farm machinery, who has kindly supplied these figures, considers that Britain has probably reached saturation point with numbers of tractors and attachments, but that they will still further improve – the tractor becoming more versatile and being fitted either with hydraulic transmission or more gears and self-hitching attachments.

Time study and labour saving

The shrinkage of man power on the farms has for a long time stimulated the invention of labour-saving and automatic devices, and the wide distribution of electricity in rural districts has enabled large numbers of farmers to use them. They will certainly increase in the future.

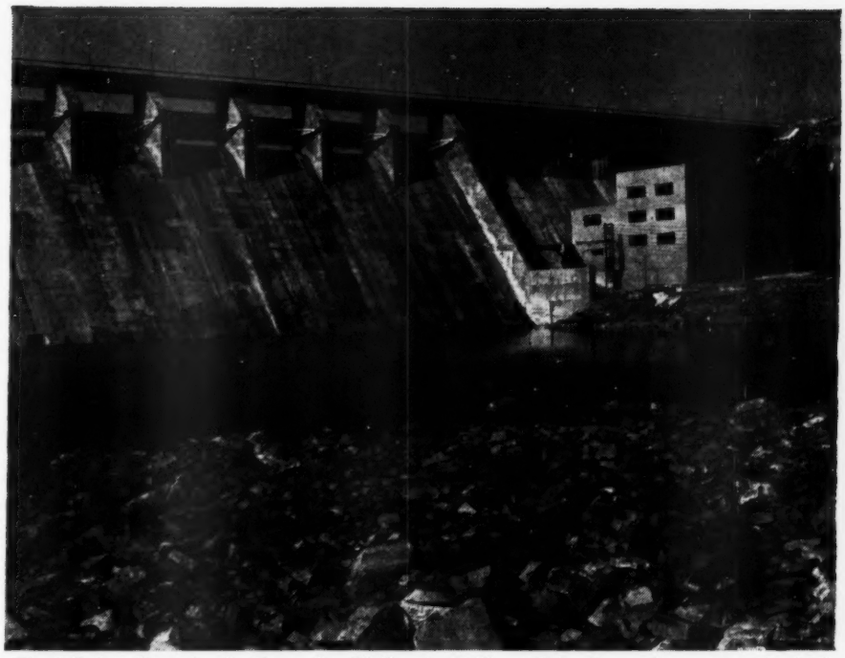
Great economies will result from the use on the farm of the work studies that have proved so valuable in industry, in which all the actions and movements that go to make up any piece of work are carefully observed in the hope of finding smoother and quicker ways of doing it. I.C.I. set up a unit under Gordon Lugg to see what could be done in this way and some of his observations show considerable possibilities of economising time and labour: on one farm a pig unit of 30 sows producing 500 baconers a year was raised to 85 sows producing about 1,400 baconers a year; and on another farm a milking throughput of 17 cows per hour was raised to 30 cows; in both cases by making changes that eliminated unnecessary walking and carrying, and without having to increase the labour force.

Next comes automation

The most remarkable development in mechanisation during the past decade, however, and perhaps the most portentous of this age, has been

the linking of these automatic devices with electronic controls. Some astonishing results have been achieved in manufacturing industries and a beginning has been made for agriculture. Last September a tractor on the Reading University farm started off without any human intervention, but subject only to an internal electronic control; it followed its prescribed course, obeyed the traffic lights, threw out its bales of hay from the trailer at the proper places and stopped when it had done its job. Had anything thrown it out of its course it would not have gone blundering on, but would have stopped, so would it have done had it struck some obstacle.

The way seems open now to a machine that will start out from its shed at the prescribed hour in the morning, proceed on its allotted round, carry out the tasks assigned to it, and then, when all is done, return home, all without any human intervention. The American journal, *Time*, recently described an automatic farm in Indiana where the farmer has only to push certain buttons on his electric control board and the proper mixtures of ground maize, shelled maize, silage, supplementary vitamins, mineral and hormone nutrients are made up and delivered to a herd of 400 Hereford cattle in their stalls, and to 500 pigs. He had to get up at 5.30 in the morning to do this, but it took him only 10 minutes and he was then free to indulge his hobby of playing Bach's music. When he gets electronic controls this early rising will become unnecessary, as the whole system will then be self-operating. Of course, we must not deceive ourselves into thinking that all these advances will make the farmer's life simply a joy ride. Progress in agricultural practice generally means only changing one set of troubles for another.



The Tilaiya Dam in the Damodar Valley in India. This river, the waters of which were formerly very destructive, is now being put to good use

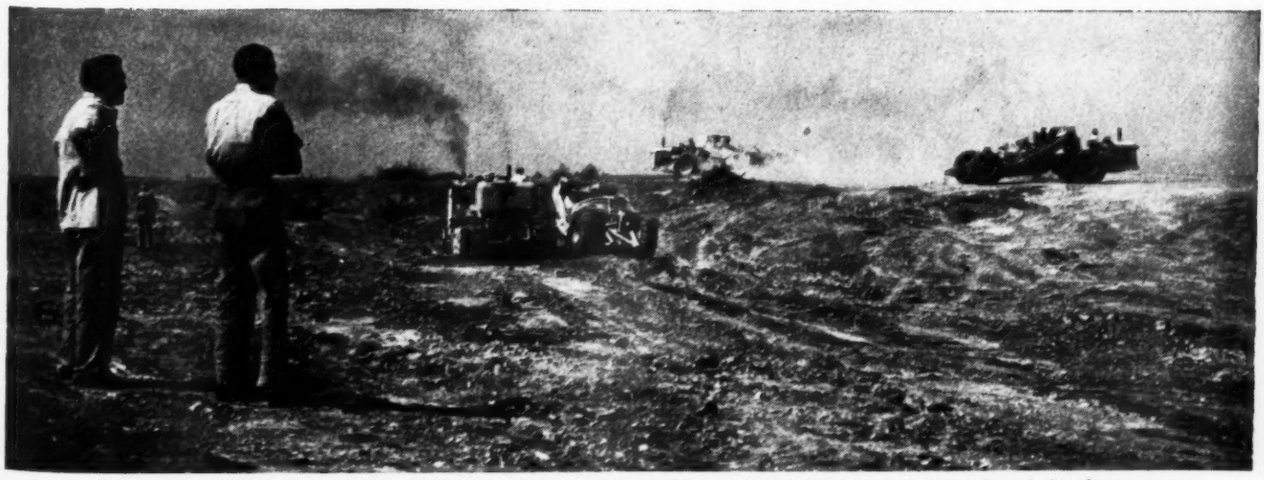
Rain making and rain control

The weather still defies control, but experiments on rain making continue and, recently, with some hopeful signs. Irrigation is increasingly practised during dry spells, and economy in the use of water is facilitated by simple appliances for measuring the amount of moisture in the soil. H. L. Penman at Rothamsted has carried out important researches on this subject.

While there is hope of doing something about a dry season, there is as yet none for making the rain stop when enough has fallen. In the wet year, 1958, the net farming income in England and Wales was estimated at £327 million, but adjusted to normal weather conditions it would have been £360 million; at this rate the wet season must have cost farmers some £33 million.

Development of under-developed lands

The developments so far described are at present mainly of interest to the advanced countries, though they are



Reclaiming eroded lands in the Damodar Valley, India, prior to afforestation and agricultural development

more and more coming into use elsewhere. Increasing attention is being paid to the development of agriculture in the under-developed countries, which in the main are the tropical and subtropical countries. Here the problems are complicated by the fact that agriculture is literally the way of life of the people, and its improvement not infrequently involves serious social changes.

A changing pattern

Fragmentation and scattering of holdings, shifting cultivation, neglect of soil conservation measures, all have to be given up and other practices as well. Great fundamental changes of that kind cannot be made quickly, and for a time agricultural officers have to be content with improving the details of the native system by introducing better varieties of the crops grown, encouraging the use of fertilisers, dealing with pests and diseases, and other straightforward changes. The results, however, are not long adequate; increasing medical services lead to marked growth of population and increasing knowledge of the world raises demands for many things that only manufacturing countries can supply – motor buses, bicycles, wrist watches, soft drinks and other things obtainable only by purchase. This, therefore, necessitates development of cash cropping.

But piecemeal improvements of the native systems are not sufficient; it is now recognised that the native methods of land use in the under-developed countries are not suited to modern requirements and may even lead to soil destruction. Furthermore, these methods must be replaced by others suited to the soil and climatic conditions, capable of development as the requirements of the people expand, and at the same time not only conserving the soil, but also increasing its productiveness. The world population is steadily rising, but the area of cultivated land does not increase proportionately. Demands for housing, transport and other things continuously withdraw land from food production.

But far more serious losses are caused by soil erosion and, although the advanced countries now adopt effective rehabilitation methods, many of the less advanced do not. Soil erosion remains as one of the most serious problems that this generation is handing on to its successors; it is largely the result of successful health services increasing the pressure of population on the land.

More research needed

Solution of these and other problems that will arise necessitates in the first instance research on a broad scale to find out the ecological conditions of the various regions and to discover the fundamental principles on which better and healthier cropping systems must be based. The great research station at New Delhi, under Dr. B. P. Pal, is doing work of this kind for India; and the East African Agriculture and Forestry Research Organisation set up at Muguga, Kenya, under the direction first of Sir Bernard Keen and now of Dr. E. Walter Russell, serves a great expanse of tropical Africa. Other under - developed lands associated with Britain, France and Belgium have their research stations also and, although in some cases political activities are reducing their usefulness, steady progress is being made.

The technical problems of feeding the world's increasing millions could be solved if the ways were left clear for the scientists and technicians. It is not only the native cultivator that has to learn new methods: the expert trained in temperate climates is equally in need of enlightenment and must approach the problems of the tropics in deep humility, for he is apt to find unexpected differences from all that his previous experience would lead him to expect. That is where residence is so essential to the agricultural expert; no visitor can do more than suggest a few ideas that may or may not prove useful. Happily, this is being increasingly recognised, and there is every hope that the next decade will prove at least as fruitful as the last.

Progress in Bulgaria

Bulgaria is the second country in Europe, after the U.S.S.R., to have completed the building of a socialist system of agriculture. Co-operative farms now cover the whole country. The average acreage of the 1,000 co-operative farms remaining after voluntary amalgamation earlier this year is 11,000 acres. Each has an average of 2,000 active co-operative farm members (see WORLD CROPS, 1959, **11**, 220).

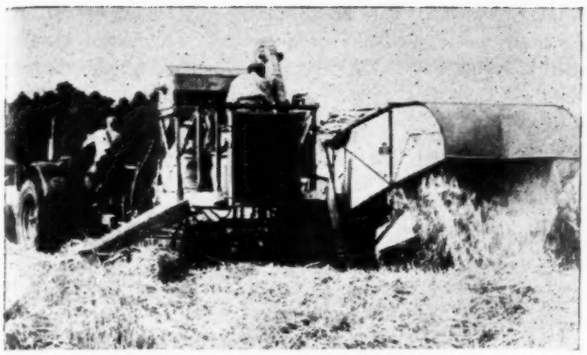
Machines now at the disposal of farmers total 30,000 tractors (in 15-h.p. units), over 5,000 combines, 4,500 threshers and thousands of other implements. Whereas in 1939 there was one tractor (15-h.p. units) per 6,000 acres, last year the figure was one tractor per 400 acres of cultivated land. Last year machines performed almost all the deep ploughing, 89% of the sowing of grain crops, 98% of the threshing and 30% of the cultivation of earthed-up crops. Half the harvesting was by combine and many labour-consuming processes in livestock farming have been mechanised.

The land area under irrigation has grown from 90,000 acres in 1944 to 4,500,000 acres last June, embracing nearly 13% of all the cultivated land. Mineral fertilisers were practically unknown in Bulgarian villages before the war. From 1934 to 1939 only 11,000 tons a year were imported from abroad. Last year, however, farms received 207,000 tons of Bulgarian-produced fertiliser and, with imported fertiliser, a total of 310,000 tons. This year farms will have 700,000 tons of Bulgarian-made fertiliser.

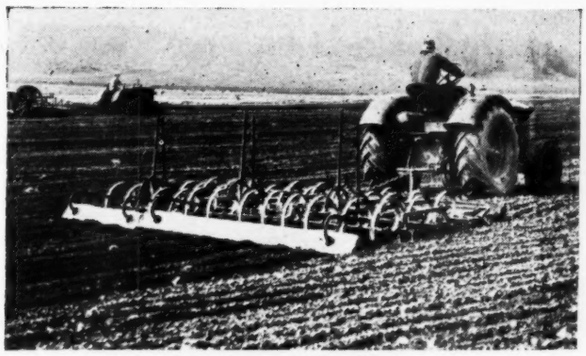
All co-operative farms have built livestock farms for cows, sheep, poultry and pigs. Average milk yields of cows at co-operative farms rose from 572 litres of milk in 1950 to 1,633 litres last year. At the comparatively few State farms average milk yields per cow reached 3,283 litres last year.

A comparison of average annual production in the periods 1934–39 and 1953-57 shows a 7.7% increase for wheat, 29.3% increase for maize, for sunflower 50%, cotton threefold, tomatoes seven times, apples six times and sugar-beet over six times. In the past 10 years average yields per acre of major crops have risen by between a quarter and a third.

Higher yields have brought greater prosperity to the farm population. More than a third of the peasants in the countryside are now living in new houses built since the war and 3,610 villages have electricity supply.



Harvesting winter wheat in Sweden



Harrowing and levelling

Agriculture in Sweden

W. LEONARD HILL

THE great increase in production in Swedish agriculture during the last 50 years is essentially due to the progress made in agricultural research and to practical application of the results, all based on a sound foundation of agricultural education and combined with a steady expansion of the agricultural machinery industry in Sweden.

The author of this article was a member of a delegation of the Food Group of the Society of Chemical Industry which visited Sweden in June.

Agriculture and forestry

The principal crops of Sweden are oats, wheat, rye, barley, potatoes, rape, roots and fodder grass. The forests are very extensive and cover one-half of the land surface of the country. They consist chiefly of pine, spruce and birch, supplying wood pulp for the paper-making and rayon industries and also timber fuel, pitch tar and creosote. Agriculture in Sweden is very highly mechanised, about 11,000 tractors and 1,400 combine harvesters being sold each year; of these, about 50% and 87% respectively are of Swedish manufacture.

Swedish agricultural education has very extensive ramifications. It comprises higher and elementary education and general and specialised instruction for both men and women.

Agricultural education

The Royal Agricultural College at the beautiful old-world town of Uppsala was established in 1932 and is engaged in the training of teachers, agricultural advisers and agricultural research workers. The B.Sc. degree may be obtained in agronomy, animal husbandry, agricultural economics, farm machinery or general agriculture and the course takes from four to five years. Higher degrees are the M.Sc. and D.Sc.(Agr.).

The purpose of the *Royal Veterinary College* is to produce veterinarians and to do research in veterinary science. The degree course covers such fundamental subjects as anatomy, chemistry, physiology, pharmacology and general pathology. A doctor's degree may be obtained after a thesis which has to be given in public.

In the *Royal College of Forestry* in Stockholm higher forestry instruction is given and research is carried out. The College has eight departments: forest technology (logging and transport), forest soil science, forest botany, forest mensuration and management, forest zoology and wood technology.

In the Department of Geodosy of the *Royal Institute of Technology* land surveyors are trained and the subjects covered are geodosy, photogrammetry, cultivation technique, real estate technique and land drainage engineering.

The *Agricultural Dairy and Horticultural Institute* at Alnarp is divided into three branches with training and research at higher and lower levels. The State Dairy Research Station and the State Horticultural Research Station are attached to the Institute. In the dairy section research is done in dairy chemistry, bacteriology, technology and economics. In the horticultural section experimental work is included in the training – after a two-years' course a degree 'Hortonom' can be obtained. The Horticultural School provides a short course for gardeners. In addition, there are 51 farm schools which provide elementary training in agriculture, six agricultural schools for training managers and owners of large estates, and four agricultural vocational schools which receive young students for instruction in agriculture and economics.

There are six forest schools for training organisers of forest operations, and the Forest Conservation Board also has courses of varying length which are arranged annually at 29 centres.

County Agricultural Societies arrange each year a large number of instructional courses in general agriculture and they provide an advisory and instructional service.

In 1943 the *Federation of Swedish Farmers' Associations* founded their own correspondence school, the L.T.K., in order to supplement the work of the agricultural schools, which in recent years have been unable to keep pace with the young farmers' thirst for knowledge.

Agricultural research

The board of the *Royal Agricultural College* and of the *National Agricultural Research Centre* has over-all control of all research work in agriculture and forestry. They are at present divided into 18 departments: inorganic chemistry, organic chemistry, plant systematics and genetics, plant physiology, plant pathology, plant husbandry, pedology, microbiology, agricultural hydrotechnics, soil management, animal breeding, animal physiology, animal nutrition, farm economy, agricultural marketing, farm machinery, physics, meteorology and statistics.

There are a very large number of state research institutes covering all aspects of plant breeding, plant protection, dairying, agricultural engineering, forestry, tree breeding and food preservation.

Hamra Dairy Farm

The approach to the Hamra Diary Farm of Aktiebolaget Separator turns off one of Sweden's new super highways, which have dual three-way lanes, clover-leaf crossings, fly-overs and separate tree-lined bicycle and pedestrian roads. Hamra is a village, the economy of which is almost wholly based on the A/B Separator, better known in Britain as the Alfa-Laval or De Laval.

The farm is both commercial and experimental and, in addition, the company runs free training courses. A five-year rotation is followed: first year, winter wheat; second year, roots and peas; third year, spring wheat under sown grass and clover; fourth year, half hay, half green fodder; fifth year, half hay, half winter rape. Much land in this country is sown with rape because farmers are obliged to grow a percentage of this crop, which the oil crushers are obliged to buy. The grass is cut young and silage is made in a silo 27 ft. high by 22 ft. in diameter. No molasses or other additive is used. The grain drier and grain storage follow modern practice.

Agricultural practice

According to Stig Beskow, technical director of the firm, no spraying of any description is practised on this farm, but the cultivated ground was quite clean. The pastures are sown with a seed mixture containing 1 lb. red clover, 1 lb. alsike clover, 2 lb. white clover, 5 lb. timothy grass, 2 lb. meadow grass and 3 lb. rye-grass, making a total of 14 lb. per acre.

Those pastures which are artificially irrigated are treated with 440 lb. superphosphate, 180 lb. muriate of potash and 1,000 lb. nitrate of potash per acre.

The remaining pastures, which are non-irrigated, and which are grazed by the young cattle, are fertilised with about 220 lb. of superphosphate, 100 lb. of muriate of potash and 250 lb. of nitrate of potash.

The dairy

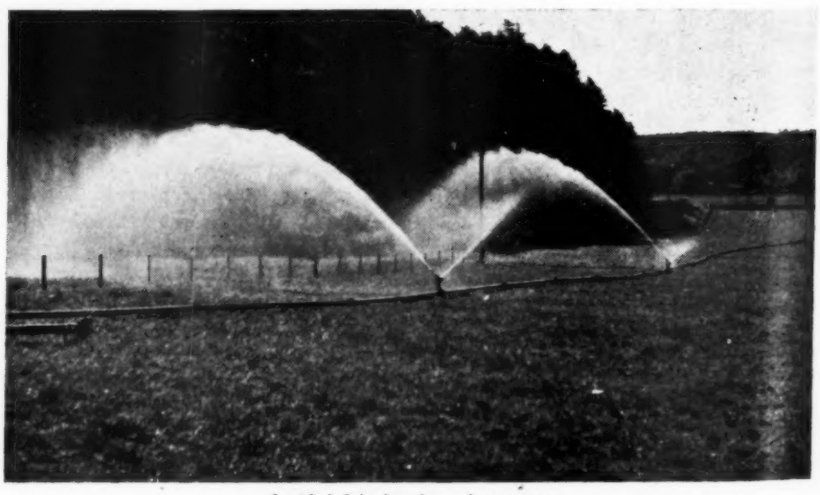
The milking parlour is lofty, light and in keeping with modern dairy practice and techniques. It has standings for about 160 cows, with no hay stored above the cow standings. The floors are tiled and the stalls are covered with composition which provides good insulation and is very easy to clean. An endless conveyor carries away the dung and it is elevated for loading into muck spreaders. The liquid is collected into covered conduits in a narrow channel below.

The herd

The milking herd consists of Ayrshires and the native Red and Whites, together with some famous stock bulls, and the herd is both tubercle and abortion free. Some of the milk is immediately separated to provide skim milk for the calves, and naturally the equipment used is of Alfa-Laval's latest design.

Of particular interest was a new piece of equipment for scouring the teat cups and tubes of the milking machines by a pulsating motion. This equipment, which was demonstrated at the 1959 Royal Show at Oxford, should save time and labour in the dairy and will undoubtedly reduce the possibility of milk spoilage resulting from faulty cleaning of equipment.

Slat-conveyor and channel for the collection of manure and urine



Artificial irrigation of pastures

Power Farming

Oil for the Tractors of the World

THE OLD WAY . . .
Subsistence agriculture in the Andes. Such primitive tools are giving way to powered implements and modern methods

THIS year is the hundredth anniversary of the discovery of oil. From prehistoric times, and throughout most of our history, unceasing labour produced the fruits of the land; first with a crudely-fashioned hoe and rake; later with an ox- or horse-drawn plough; and by the 18th and 19th centuries with implements powered by water, wind and steam.

Then, in Pennsylvania in 1859, a man drilled a hole and at a depth of 69½ ft. he met success with the first oil well ever drilled. The man was 'Colonel' Edwin Drake and his project at that time had no agricultural significance.

Oil takes a hand

Oil was first used on farms as kerosene for lamps. By 1870 lubricating oils were in increasing use, and oil was also providing liquid fuel for boilers. The 20th century saw the arrival of the internal combustion engine – and oil came into its own. Petrol, once regarded as both useless and dangerous and burnt off as waste, was to provide the means for the new age of power farming.

The internal combustion engine entered farm work in the 1890s in the shape of stationary petrol engines. Then a petrol engine was mounted on a truck, the two being geared together so as to form a self-propelling unit, and so the tractor was born.

. . . AND THE NEW
Oil takes a hand. A mechanical harvester and a tractor in action in the Turen Agricultural Settlement, Venezuela Photo: Shell

The tractor arrives

Like their steam-driven rivals, these early tractors, developing 30, 40 and 50 h.p. at the drawbar, were heavy and cumbersome, but they proved their worth in the wide open spaces of the U.S.A. and Canada. From smaller farms came the inevitable demand for lighter and more manoeuvrable tractors until, by 1916, tractors of 8 and 10 drawbar h.p. were being produced. These machines brought power farming within reach of hundreds of small farms in North America. At that time about 100 companies in the U.S.A. were making tractors and 30,000 were produced in one year.

Highly-refined fuels were expensive after the war and European factories began to turn out tractors with diesel and 'hot-bulb' compression-ignition type engines for use with the cheaper heavy fuels. Meanwhile the all-purpose tractor had appeared in the U.S.A. It could plough and, with suitable attachments, could also carry out certain planting, harvesting and spraying operations. The thirties saw the advent of the rubber-tyred tractor further to speed farm operations. Ten years later tractors appeared equipped with hydraulic, vacuum or compressed-air devices for lifting or regulating implements.

Mention must also be made of the crawler tractor, which had also passed through its initial development. This machine differs from the wheeled

The search for oil by the Campania Shell de Venezuela in the jungle-covered, roadless swamps of the delta of the River Orinoco. Here a helicopter is bringing in electronic equipment for seismic recording

tractor in that it runs on two endless metal-linked treads. It can be used for heavy farm work and for clearing and forestry operations.

Oil and the engine

Oil fuels have played a significant part in tractor engine designs. The modern agricultural tractor engine may have one, two, three, four or six cylinders, but the 4-cylinder engine is most commonly used. Engine speeds are slower than in motor cars. A typical multi-cylinder tractor engine will have a maximum governed speed of the order of 1,400 to 2,000 r.p.m. (compared with the engine of a 4-cylinder family car, which may reach 4,500 r.p.m.), but there are others outside this range. A 2-cylinder diesel engine might have a maximum speed of perhaps 1,200 r.p.m.; a single-cylinder diesel perhaps 750 r.p.m.

Today the vast majority of tractors are designed to run on diesel fuel, petrol or vaporising oil (power kerosene) and the three main classes of tractor engines correspond with these types of fuel.

Diesel fuel is commonly used in high-speed compression-ignition engines. Although more costly than the spark-ignition engine, the diesel, with its high thermal efficiency, is economical in fuel. The others are fuels for spark-ignition engines. Petrol, being highly volatile, gives a good starting performance, but the less volatile vaporising oil will not start the engine from cold and a subsidiary tank of petrol is usually needed for this purpose.

The type of fuel used is, in the main, determined by local conditions and sometimes by taxation policy, *e.g.* in the U.S.A. more than 80% of the tractors are powered by petrol, which is free of tax for agricultural purposes. In most other countries (where petrol bears a heavy tax) vaporising oil-powered engines are popular because this fuel is usually untaxed. Nowadays diesel engines are being used more and more in agricultural countries where diesel fuel does not carry a high tax, or enjoys some tax concession, if used for agricultural purposes.

In Germany, Austria and in various Eastern European countries nearly all the tractors produced are diesel-engined; and this is true of over half the tractor production of Switzerland, France, Italy and Sweden. In the U.K. approximately half of the agricultural tractors burn vaporising oil, but the proportion of diesel tractors is increasing and the consumption of diesel fuel used in agriculture is greater than that of vaporising oil.

Ample oil reserves

In 100 years man has thus progressed from the use of primitive agricultural tools to complex oil-powered machinery. Future food requirements call for power farming on a constantly increasing scale, and more fuel will be needed for more farm machines. What resources exist for keeping the wheels of agriculture spinning?

At the turn of the century world oil consumption was 150 million barrels a year; this rose to 500 millions by 1917 and doubled again by 1924. Currently consumption of oil is estimated at a rising 7,000 million barrels a year.

Despite this phenomenal increase in demand, a vigorous programme of exploration and development by the major oil companies, largely financed from earnings, ensures the world abundant oil now and in the future. During one 10-year period (1947–56) the world oil industry spent an estimated 69,000 million dollars on capital investment and exploration.

Each year new reserves are discovered exceeding the quantity produced. Last year producible crude oil reserves were estimated at 275 thousand million barrels. This is more than twice the estimate of five years ago and four and a half times greater than 10 years ago. There are now available proven reserves two and a half times greater than all the oil yet produced.

Tractors in Britain

The total value of the U.K. output of agricultural tractors, machinery and parts in the first quarter of 1959 reached a record figure of £41½ million, compared with £36½ million in the corresponding period of 1958.

Compared with 39 thousand in January–March 1958, 41 thousand British agricultural tractors were delivered in the first quarter of this year and three-fifths of these were for export. Just over one-fifth of other agricultural machinery and spares production was for export. Despatches of pick-up balers continued to break records, but combine harvesters were down.

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

Breaking the Hard Pan

W. H. KETCHELL*

Subsoiling is a form of deep cultivation in which none of the underlying soil is brought to the surface, nor is the top soil buried deep underground. It is an operation which improves moisture conservation, improves root penetration and makes available hidden sources of plant nutrients.

THE operation of subsoiling (disturbing and opening the soil to greater depths than that achieved by ploughs, harrows or hand implements) is now extensively known and its effects are well appreciated in Europe and North America. Probably because it requires the ownership of a tractor, it is an operation that is comparatively unknown and unappreciated in Asia, where it is possibly of even wider application and of even greater importance to agriculture.

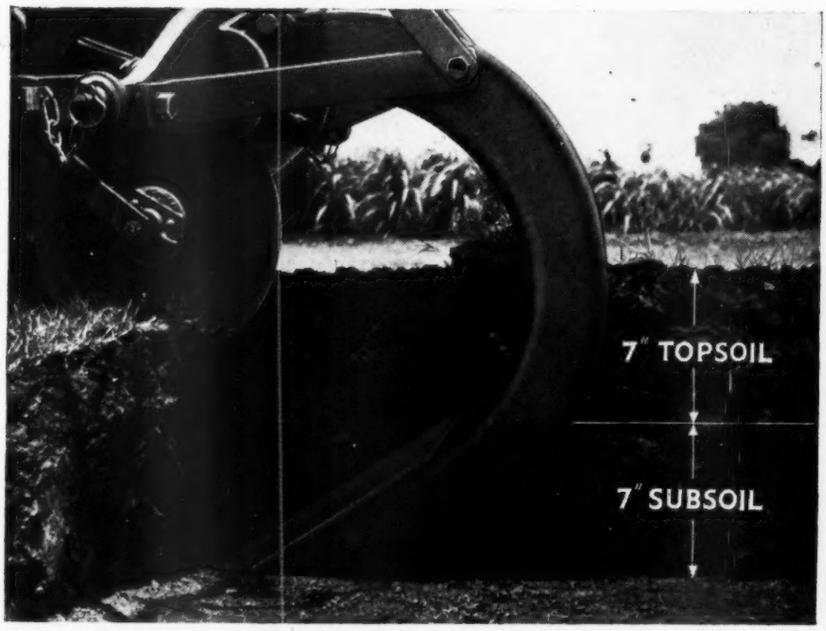


Fig. 1. Cross-section showing the subsoiler in position and the disk-coulter cutting the turf in advance. Note the soil has been removed from one side of the subsoiler to expose the soil profile

The subsoiler

This implement is basically a very strong and narrow hard-steel standard, formed in the shape of a hook and mounted at the rear of the tractor. It is fitted with a reversible and renewable point and, also, normally with a wheeled coulter for cutting through surface growths. It will be appreciated that to operate in the subsoil far below any previous operation it is necessary that the implement should be built of materials and to a design that will adequately withstand heavy shock loads and be operated by a tractor of adequate power and traction.

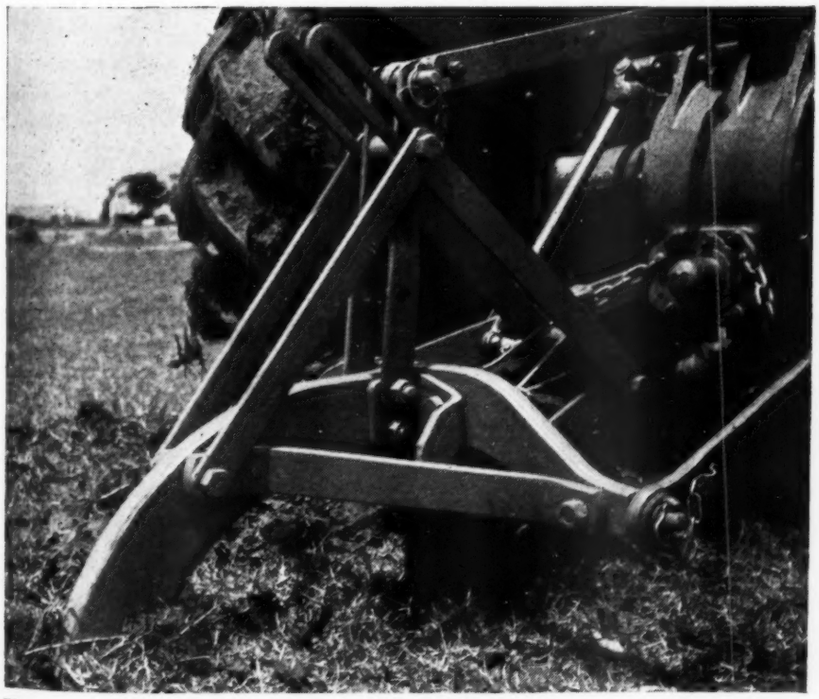


Fig. 2. A Massey-Ferguson '35' diesel tractor and subsoiler operating at 16 in. depth in grassland

'Hard pan' formation

In land that has been worked continuously for many years the repeated movement across the surface of working animals and farm carts exerts a downward pressure on the soil. Although the top few inches of soil may be regularly loosened by cultivation each time the soil is prepared for cropping, this pressure will eventually consolidate the soil beneath the seedbed to produce an impermeable pan.

In certain Eastern countries, where

* Resident Director, Massey-Ferguson (India) Ltd.

food crops are grown year after year in the same soil with little effort being made to improve the soil tilth by crop rotation, incorporation into the soil of crop residues etc., the formation of ' hard pan ' is hastened because over-cropped surface soils lose their porosity and cannot fully absorb the rainfall during heavy monsoon showers; consequently the subsoil remains in a dry and hard condition.

Effects of ' hard pan '

After such a ' hard pan ' has formed the movement of rain water through the subsoil is severely restricted and during periods of heavy rainfall erosion due to heavy run-off is likely to occur on sloping lands, or water-logging will develop in low-lying areas of flat fields.

Thus, although a heavy fall of rain may occur, only a negligible amount of water can penetrate into or pass through the ' hard pan '. In consequence it often happens that plants which make a good start will weaken and fail later after the rains are over and they have used up all the available moisture in the topsoil and there is little or no moisture available in the subsoil.

For the same reason, too, since the water cannot pass downwards, the flood water must disperse laterally by surface wash. The more readily-soluble mineral nutrients are leeched away, while the topsoil becomes increasingly deficient in essential plant foods through successive cropping without renewal. Minerals are available in the subsoil, but the roots cannot reach down because of the restricting ' hard pan '. This insulation cannot normally be corrected by deep ploughing, as the plough does not go deep enough to crack the pan, and if it does the loose topsoil is completely buried.

The function of the subsoiler can be readily understood from Fig. 1, which shows the implement operating in a typical compacted soil. Beneath the topsoil, which may extend to a depth of 12 in., will always be found a layer of compressed soil, which is referred to as the ' hard pan ' and is of variable depth. It is this ' hard pan ' that is loosened by the passage of the subsoiler.

The effects of subsoiling

Proof of the value of subsoiling is surely offered in the illustrations given of Ragi, *Eleusine coracana*, grown on dry scrub land in Mysore State. Fig. 3 shows a very representative crop such as is obtained on land which had been prepared in the usual way; it grew to an average height of only 10 in., being extremely weak, thin and sparse. The other photograph, Fig. 4, depicts the standard of plant obtained after sowing similar seed on soil immediately adjoining, which had been subsoiled before ploughing and which, whilst standing 27 to 30 in. high, had greater vigour and normal healthy growth. This satisfactory result was obtained throughout the subsoiled area with absolutely identical treatment and without the use of any fertilisers or manures.

In summary, it was found that an area which was yielding ragi at the rate of only 800–850 lb. per acre – well below average – was enabled to give a normal yield of 1,200-1,300 lb. per acre entirely as a result of using the subsoiler.

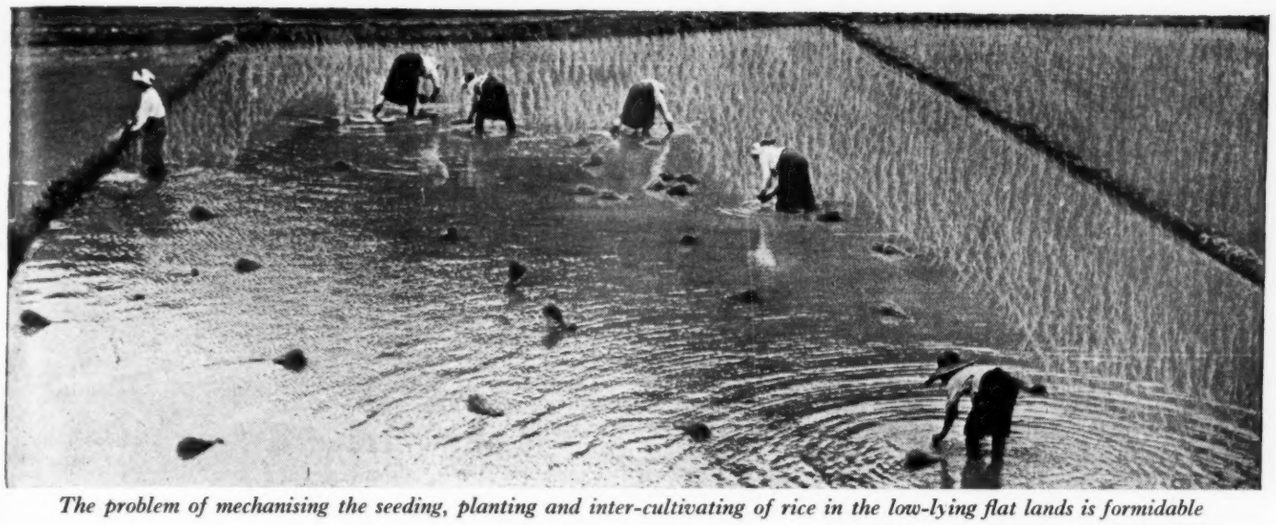
It was found during growth periods that, whilst no moisture could be found to a depth of 12 in. with normal cultivation, subsoiled land showed moisture to be present within 4 to 5 in. of the surface, even after a long period without rain.

In subsoiling, which was carried out at intervals of 24 in. across the gradient and to a depth of 18 to 20 in., it was found that fragmentation or cracking of the ' hard pan ' had occurred. This allowed water to pass directly downwards into the subsoil at time of rainfall and to be drawn upwards again later by capillary action by the roots of the plants and by the sun. It may be assumed, too, that through being able to penetrate more deeply the roots could find any necessary mineral nutrients lacking in the topsoil.

Following these encouraging results, further work is to be done in other areas and with other crops, as it is considered that this operation is likely to have an important influence on dry land farming generally.

Fig. 3 A sparse crop of ragi produced on land which has not been subsoiled

Fig. 4. A good crop produced on adjacent land which had been subsoiled before ploughing



The problem of mechanising the seeding, planting and inter-cultivating of rice in the low-lying flat lands is formidable

The Machine in Tropical Agriculture

II—Uses and Limitations of Agricultural Machines

RAY WIJEWARDENE, B.A. (MECH.SC.), M.A., A.M.I.B.A.E., M.A.S.A.E.

In Part I the author discussed the limitations of the machine in tropical agriculture. Here he discusses the application of mechanised methods on well-drained gently undulating land in wet and dry zones, and also on the flat low-lying coastal plains, where rice is mainly grown.

VERY little is known about the most suitable form of cultivation for 'B' type soils. Attempts so far to adopt, wholesale, the temperate practices of ploughing and harrowing have resulted in considerable damage to the land. Only comparatively recently has a proper study begun of this very important subject and the work done in Ceylon by Mr. Ernest Aberyratne at the Maha Illuppallama Research Farm of the Department of Agriculture of Ceylon deserves particular mention.

So far his results indicate that any practice, such as ploughing, disking etc., which exposes the soil is 'taboo', for the soils must be kept covered at all times, and preferably with a low dense-growing legume, if fertility is to be maintained and erosion checked. From these fundamental precepts cultivation practices vary according to the crop grown.

Mr. Abeyratne believes the most suitable practice when dealing with arable crops in rotation with a perennial leguminous pasture is to cultivate and plant the seed simultaneously at the onset of the rains (hoping they will not be too severe) by opening a narrow strip of soil a few inches broad in the leguminous cover, into which the seed is dropped, covered and strip fertilised, all in one operation.

Slashing and mulching

In the two-monsoon wet zone the most desirable practice would seem to be some sort of slashing or mulching process by which the cover, preferably a leguminous pasture, is kept low and under control, thus returning all the slashed vegetation to the surface of the soil without necessarily exposing it in the process. Rotary weed slashers, mowers and roller mulchers have been found to perform these functions very well, although the latter appears most favourable, as its action also includes a form of soil aeration and general loosening which is believed to be beneficial.

Tractor-mounted implements

In certain instances, such as in the case of coconut plantations, it may be necessary to go further in aeration, even to the occasional use of an implement such as a subsoiler, for, although the action on the roots of the palm have not been studied fully, root pruning is believed to be beneficial if not overdone.

Various other tractor-mounted implements have been found useful for plantation crops in the 'B' type soils – these include the post-hole borer for digging planting holes, the tractor-mounted pump for lift irrigation, and the fertiliser drill when adapted for placing fertiliser into the relatively uncultivated soil, rather than just spreading it over the surface, where it is liable to be oxidised, blown or washed off the land.

One drawback with mounted implements when used for the cultivation of these plantation lands is their lack of flexibility laterally. Trailed implements which follow the tractor around the trees and yet which can be raised for transportation to the field and over furrows and bunds would be preferable.

In the sheltered areas of the tropics, where monsoons are less intense, some measure of success can be achieved by the cultivation of arable crops in the 'B' type soils, but these are risky and can only be considered practical when used for fodder, either direct fed or ensiled.

Cage-type paddy wheels fitted to the Landmaster ' 150 ', enabling the machine to be used for ploughing flooded fields of paddy

Dry zone operations

' B ' type soils in the dry or single-monsoon zones are more of a problem, as so very little is known fundamentally about the crops which will tolerate these very extreme conditions. The reader may recall the East African groundnut scheme in Kongwa, a typical ' B ' type single-monsoon zone venture, where machines were used with such unfortunate results.

High forest areas

The tractor has also proved to be singularly unsuitable in the 'A' type lands, since it requires more or less level and smooth ground on which to operate. Very clearly quite a different approach is needed, but it would be worth the effort, as the labour requirement in these 'A' type tea, rubber, coconut and cocoa plantations is very high with on occasions a labour force of one man per acre.

Machinery has been made use of to a limited extent in the harvesting of crops such as tea, but these cannot really claim to have developed much beyond the experimental stage.

Flat lands

We now come to the ' C ' type, most interesting to the machinery manufacturer, as this is about the only type of land on which tractor cultivation of paddy is practicable, *but under the fundamental proviso of controlled irrigation, unfortunately rare in these parts of the world.* Rain-fed paddy lands are too risky a proposition for systematic cultivation by machine.

Under conditions of precisely controlled irrigation very complete tractor working is possible from ploughing to combining. But the number of paddy tracts in the tropics on which such precise conditions prevail are very few.

Invariably in the East an irrigation scheme is supplementary to rain-fed condition, which is almost as bad, for one heavy shower can reduce an otherwise perfect field into a quagmire quite incapable of supporting a tractor.

For the tractor to be suited to rice cultivation all cultivation and harvesting processes must be carried out during the drought or dry weather seasons under pump or gravity irrigation. This, therefore, tends to eliminate the two-monsoon zones, except where rains are so light as not to matter much.

Seeding, planting and intercultivation

The problems of seeding, planting and intercultivation are also formidable in these areas. Attempts have been made in Malaya to develop paddy broadcasting fiddles to reduce sowing labour, whilst other countries have dabbled with transplanting machines without too clear an idea of the reason for this process.

In Italy and Japan transplanting enables two long-term crops to be grown on the same land each year, such as winter wheat rotated with paddy in the summer. Maximum use is made of the few sunny months to start the paddy plant off in a nursery whilst the wheat is maturing. It is then transplanted into the wheat field immediately after harvesting.

In certain swamp areas of Malaya, in which the operation of the tractor is quite unsuitable, transplanting is the only way to establish a crop in fields which are permanently covered with water.

A solution developed in Japan, and

(*Continued on page* 364)

A Landmaster ' 150 ' tractor fitted with an irrigation pump delivering 6,000 gal. per hour into a paddy field

Some Aspects of Improved Land Utilisation

T. A. JONES,* M.SC., F.R.I.C.

This is a sequal to a previous article, written by Prof. Dudley Stamp, which appeared in WORLD CROPS, 1958, 10, 123, and is based on land utilisation operations in the Caribbean.

WORLD land utilisation, as discussed by Professor Dudley Stamp (*vide* WORLD CROPS, 1958, 10, 123), was most appropriately referred to as a challenging subject. The article, it was suggested editorially, should be brought to the notice of agricultural administrators and others whose task it is to guide nations in these difficult and troubled times. Additional emphasis would therefore seem appropriate on some of the principles that require greater clarification and more precise definition before appreciable advance in improved land utilisation can be planned on an extensive scale.

Productive efficiency

The measurement of actual output and of potential output of different types of land and of different farming systems is an important consideration in developing a scientific approach to the problem of improved land utilisation. In this respect, use of the Standard Nutrition Unit (S.N.U.) as proposed by Professor Stamp is a valuable suggestion, especially since the unit can be calculated independently of the crop grown or of the food consumed. This latter fact, indeed, endows it with some of the necessary qualities of a good unit of measurement. By its use some instructive comparisons and generalisations can be drawn.

The practical value of the unit in this form is however limited, as Professor Stamp implies. Distinctions are required, for example, between temperate countries of highly organised farming systems and tropical countries where we must learn 'properly to tame and use tropical climates and soils'. Distinctions of this kind essentially involve marked differences in farming systems, in which case the critical emphasis falls on the area of land required to produce one Standard Nutrition Unit. An inefficient farming system—such as one of the many forms of shifting cultivation practised in tropical countries—will display a very high acreage figure per S.N.U. produced. This figure will still however only provide an interesting comparison with that obtained from a relatively efficient farming system as found on the fertile soils and kinder environment of temperate climates.

The straightforward comparison is then only a very slight contribution to the main problem of improved land utilisation. An acreage figure per S.N.U. produced is, in fact, simply a measurement of actual output. The need remains to link the unit of measurement with potential output before any insight into improved land utilisation is gained. Improved land utilisation is obviously a problem of how to increase productive efficiency.

Productive efficiency can be quantitatively measured for any particular farming system by the ratio of potential to actual output of that system, and acreage per S.N.U. produced is again a very appropriate way of expressing both components of the ratio. The main difficulty is to decide what figure to accept as potential output and how it is to be determined.

The concept of land capability

Maximum yield figures from appropriately sited field experiments are a

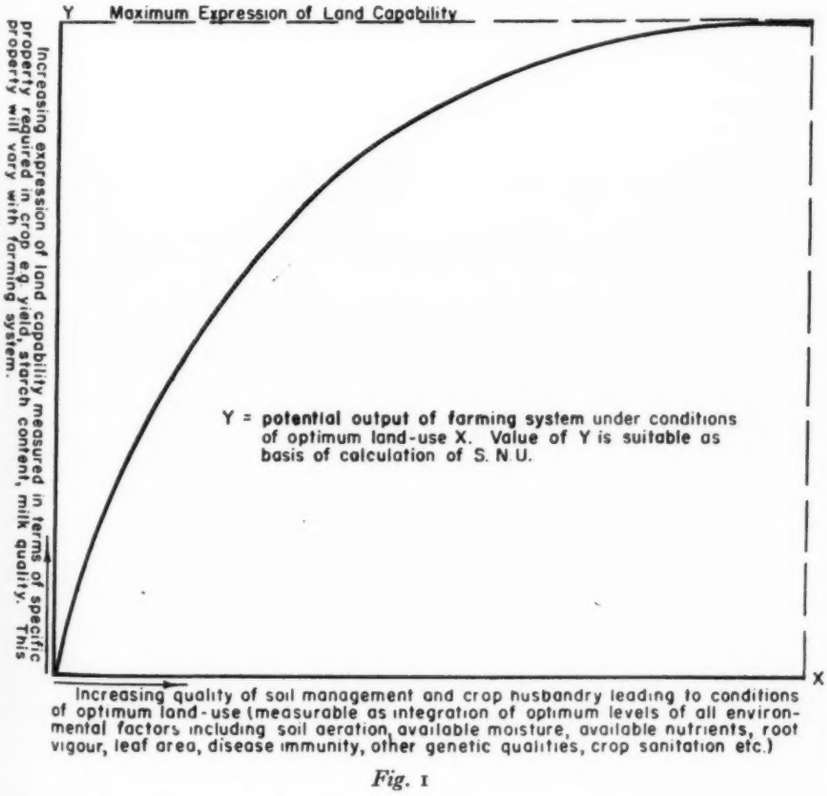

Y Maximum Expression of Land Capability
Increasing expression of land capability measured in terms of specific property required in crop, e.g. yield, starch content, milk quality. This property will vary with farming system.
Y = potential output of farming system under conditions of optimum land-use X. Value of Y is suitable as basis of calculation of S.N.U.
X
Increasing quality of soil management and crop husbandry leading to conditions of optimum land-use (measurable as integration of optimum levels of all environmental factors including soil aeration, available moisture, available nutrients, root vigour, leaf area, disease immunity, other genetic qualities, crop sanitation etc.)

Fig. 1

* Director, Coconut Research Dept., Coconut Industry Board, Kingston, Jamaica, and formerly Head of the Soil Survey and Research Dept., Imperial College of Tropical Agriculture, Trinidad.

Photo: C. L. de Freitas.

Fig. 2. Class 1 land in the foreground and middle distance. Flat, well-drained fertile soil with little or no limitations for agriculture. St. Vincent, West Indies

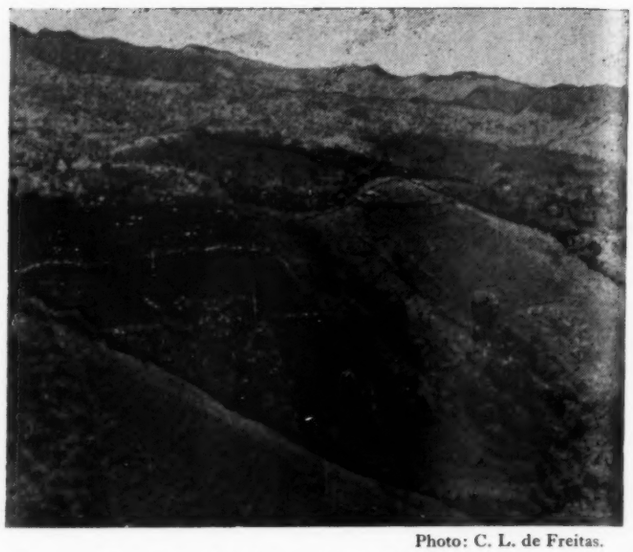


Photo: C. L. de Freitas.

Fig. 3. Class 5 land in foreground and middle distance. Steep, erodible sites suitable for tree crops, improved pasture and planted forest. St. Vincent, West Indies

sensible basis for determination of the potential output of a farming system, but the greatest caution must be taken in their use since the calculation must presuppose the highest level of soil and crop husbandry. Indeed, a subjective qualitative feature is necessary before a quantitative approach to potential output is possible and before maximum yields from fertiliser experiments may be confidently used in calculating potential output.

This qualitative feature invokes the concept of land capability, the land appraisal procedure in common use in many parts of the world. It is a subjective appraisal of the most intensive possible use of a given soil under the environmental conditions that obtain. Table 1, which shows the intensive uses recommended as appropriate to each land capability class, acknowledges degree of slope as a primary factor in determining land capability, although this need not necessarily be so. This essentially qualitative approach can be a very effective tool in agricultural improvement.

Two important facts stem from this concept of land capability:

(*a*) If soil management and crop husbandry at a given site are at a level of thoroughness which will solicit from the soil a maximum expression of its capabilities, then, and only then, are the yields at that site suitable for the determination of potential output and hence of productive efficiency.

(*b*) From the two wedded concepts of productive efficiency and land capability, the true value of a Standard Nutrition Unit will be approached *asymptotically. This will occur when soil management and crop husbandry are increasingly raised to a level permitting near approach to the maximum expression of land capability.

This very important conclusion is graphically represented in fig. 1, where the productivity curve never actually reaches the maximum expression of land capability. At this level of perfection, yield figures will become appropriate material for calculating potential output. An asymptotic limit being theoretical, absolute figures will not, of course, be obtainable, but from a practical angle, well-based approximations will be sufficient for the purpose.

* Asymptote: A condition of a curve approaching an axis but never actually meeting it.

The concept of optimum land use

The problem of measuring the potential output of a given farming system therefore resolves itself initially into the development of an acceptable procedure for Land Capability classification. This procedure presupposes a considerable degree of competence in the classifier. He must possess a thorough working knowledge of soils and of the various methods of handling them practically. He must acquire a

Table 1

The most intensive suitable uses for land in each land capability class

Land capability class	*Most intensive suitable use*
1. A* and B* slopes of good soils	Suitable for cultivation (tillage) with almost no limitations
2. Mainly C* slopes of good soils	Suitable for cultivation (tillage) with moderate limitations
3. Mainly D* slopes. Some gentler slopes of less favourable soils	Suitable for cultivation (tillage) with strong limitations
4. Mainly E* slopes. Some D slopes	Suitable for tree crops, grasses and very limited cultivation
5. Mainly E* and F* slopes	Not suitable for cultivation, but suitable for planted forest, tree crops or improved grass
6. Mainly steep rocky land or dry climate	Not suitable for cultivation. Suitable for poor forest
7. Rock outcrops, river wash etc.	Little or no productive use

* Slope categories previously determined.

sound appreciation of climatic factors within the particular environment under study, and the influence these factors have on the soil and its behaviour. He must possess a fairly extensive grasp of the agriculture of the region in which the soil occurs. He must also acquire a sensible insight into the sociology of the region, since his final conclusion and judgment on land must essentially involve the people who live on it.

In effect, therefore, he must acquire a broad grasp of the environmental conditions and also at a certain stage in the exercise be able to apply himself precisely. He must in the end integrate his appraisal of ecological and environmental conditions and arrive at a well balanced judgment of ' optimum land use '. This is intended to be *that form of land use which permits maximum expression of the capabilities of a given soil at a given site;* it implies by definition that the given soil is, indeed, being correctly managed and the crops thereon shrewdly husbanded within the restrictions imposed by the environment.

Although at first it may appear that in doing this a great deal is expected from the classifier, a little consideration will show that he is, in fact, asked only to function as a scientifically-trained farmer. A suitably trained individual, possessing at the outset the necessary enthusiasm for this type of work, can acquire the art relatively quickly.

The conditions necessary for the truest determination of potential output can now be fairly precisely defined. They are, in fact, identifiable with those conditions of optimum land use which induce maximum yields in fertiliser experiments, *i.e.*, experiments permitting maximum expression of land capability. Limitations to plant growth are reduced then only to those imposed by the unalterable factors of the environment. These unalterable factors are essentially those which contribute to the basic Land Capability appraisal.

The Standard Nutrition Unit determined under such circumstances would give a fairly reliable measure of potential output and also would enable productive efficiency to be critically calculated. Field plots, laid down with this specific intent, would be easily supervised by appropriately trained scientific personnel.

Photo: C.O.I. Crown Copyright reserved

A surveyor takes the level on a hillside and pegs out the contour for soil conservation

Crossing the theory-practice barrier

The principle of optimum land-use does, however, suffer in one respect from a lack of reality. Amongst the desirable virtues in a good land capability surveyor listed earlier, a grasp of local economic factors was deliberately omitted. This permits the surveyor a degree of licence in forming judgment which is not biased by local economics. The latter factor is not truly environmental in the biological sense and accordingly does not enter into a consideration of optimum land-use.

We are here dealing with two essentially differing aspects of the same problem, *viz.*, ' optimum land-use ' and ' practical land-use '. The first, as already discussed, introduces an element of perfection, in which all factors in the environment are handled in a way that will encourage the fullest expression of the soil capabilities. Attainment of this level of perfection involves a series of asymptotic approximations to the truth. The second aspect tacitly accepts the existence of those limiting factors such as economics and others which are ' of the people ' rather than ' of the land ', and which prevent the fullest expression of soil capability. These may be so overriding in influence as to render the practical land-use methods widely divergent from any form of optimum land-use. Under such circumstances the emphasis in the whole problem must veer towards its sociological aspects, frequently in spite of technical necessity.

In general, however, optimum land-use recommendations provide sufficient breadth of advice to offer confident pointers towards agricultural methods and crops, which can safely serve as a basis for evolving practical methods of land-use. The net result is a systematised set of procedures elaborated for every soil on every site demarcated in the field survey.

Results in this form are acceptable to agricultural administrators for putting directly into practice. It is essential, however, for the successful continuation of the work that the administrator be sympathetically disposed towards the effectiveness of this approach to land capability appraisal. Herein lies the second implied challenge mentioned in the opening paragraph.

Assuming an actively co-operative administration, the next essential step is the dissemination among the people of the knowledge gained. To this end the land-use organisation must bifurcate rapidly. One arm of the organisation must follow an agronomic course with the purpose of establishing field trials under the various environmental conditions that have been defined. At this stage much of

the subjective judgment in the field work will come under closer scrutiny and quantitative assessment. It is within the scope of this work that evaluation of the Standard Nutrition Unit for any particular farming system is possible.

The second arm of the organisation is allocated the task of more specific applications of the land-use recommendations at the level of individual farms or even of individual fields within the farms. The broader issues of the preliminary land-use survey and of the land capability appraisal within that survey are carried accordingly to an increased detail of land pattern.

Progress in the Caribbean

An organisation structured approximately according to this pattern has operated for some years within the British West Indies. The work has been financed from the British Treasury under the Colonial Development and Welfare Act of 1947. The region has proved in many ways a most appropriate choice for a land-use organisation. The West Indian islands possess most varied terrain thereby offering fair scope for the application of land-use principles.

The volcanic islands of the region are at relatively youthful stages in their erosion cycles, so that slopes are fairly steep and the volcanic nature of the parent material renders the soils themselves extremely erodible. At the same time agriculture has been practised on these islands for so long that an extremely anthropomorphic soil pattern has developed. Age differences between volcanic deposits provide inherent fertility differences. Extremely leached profiles exist from which nearly all weatherable minerals have been removed. Extremely youthful profiles of almost raw volcanic ash occur in which nutrients may be relatively unavailable to plants due to superficial coatings of volcanic glass. Very fertile alluvial soils occur which display full nutrient accumulation from the volcanic material of the higher topographic levels.

The non-volcanic islands provide examples both of youthful and senile topography on sedimentary rocks. The soils associated with these conditions vary from lithosols, in which the inherent fertility is closely associated with the nutrient qualities of the original rock, to clay soils developed on flat relief where drainage impedance is the dominant pedo-genetic process operating. Structurally these latter soils carry with them the curse of their inheritance-formation from highly micaceous materials which have given rise to silty clays.

Photo: Crown Copyright reserved

Terraced cultivation on a steep erodable slope in the Yallahs Valley. The cultivation of land with a slope of over 30 degrees is not encouraged

Added variety is provided within the area by the territories of British Guiana and British Honduras, where relatively undisturbed conditions still prevail and where soil profiles are attenuated to great depths under the prevailing tropical rainfall regime. Such circumstances have led inevitably to extremely leached and weathered soils on which the dominant vegetation is forest delicately suspended on its own nutrient cycle.

It has been possible over these variable conditions to develop a fairly uniform field procedure capable of relatively quick application. In the first place systematic demarcation of soil types in the field has been carried out, this stage itself being hastened appreciably by the use of good aerial photographs. The next stage has been the recognition of erosion as a dominant feature in the development of landscape. It is a relatively short step from this conclusion to the appreciation of the degree of slope as a primary factor in the determination of land capability.

Seven broad land capability classes, based on overall suitability for use, have been recognised in much the same way as in the U.S.A. Immediately, a broad grouping of land into seven capability classes can be obtained based solely on slope class; the slope classes accepted are subject to separate assessment by observation in the field. Taken no further than this stage, a country's available arable acreage or acreage of land requiring some degree of erosion control can be determined.

No specific recommendations on land management and crop husbandry are, however, possible. This is only acquired by the super-position of the soil survey data with its primary purpose of demarcation of soils, on to the land capability classes appropriately subdivided to suit the purposes of the survey. In general, in the West Indies these latter subdivisions include the principal limiting factors counted significant in deciding land capability.

In addition to the factors of slope and erosion risk, they include excess water in the soil seasonally, or otherwise, giving poor natural drainage; an inherent soil factor implying usually shallow or droughty soil; a climatic factor – a combination probably of low annual rainfall and a long dry season; and, finally, somewhat specific for the region, a factor of 'boulderiness' is incorporated, since this is an essential aspect of volcanic geomorphology.

At this stage it is possible to provide the agricultural administrator with a soil map and with a systematised set of tables. From the first he may recognise the limits of his soil occurrences; from the second he may obtain recommendations of land management procedures which within the limits of the soil occurrences permit a near approach to a maximum expression of the land capability of that soil.*

The work on land utilisation and

* See *Soil and Land-Use Surveys*, No. 1, Jamaica (Parish of St Catherine); No. 3, St. Vincent. Published by Regional Research Centre, Imperial College of Tropical Agriculture, Trinidad, T.W.I.

land capability appraisal within the British West Indian territories has now reached the stage where it must bifurcate – a very necessary step, as previously described. It is perhaps propitious that the field procedures in these operations have been tested and established ahead of the politically unifying principle of West Indian federation. It is unquestionably appropriate that the agronomic aspects following the initial land capability appraisal be given a regional significance and be planned accordingly.

It is a *non sequitur* to construct a political federation among the West Indian islands other than from soundly interlocking economic units. Against this socio-political issue land utilisation and land capability assessment receive their greatest emphasis. They provide, above all, a rational approach to those problems which immediately confront the new political unit.

Commonwealth Co-operation in Research

D. J. CAMPBELL, M.A., PH.D., A.R.I.C., M.INST.INF.SCI.

THE subject of this article is the work of the Commonwealth Agricultural Bureaux and in particular of those most closely concerned with cultivation of crops. The Imperial Agricultural Bureaux (as they formerly were) came into being as clearing houses to encourage co-operation and exchange of ideas between all parts of the Commonwealth and Empire. They are governed by an Executive Council, consisting of one representative from each of the independent Commonwealth contributing countries and one for the Colonial Empire.

The individual organisations at present controlled by the Executive Council include the Commonwealth Institute of Entomology, the Commonwealth Mycological Institute and the Commonwealth Institute of Biological Control in Canada and also the Commonwealth Bureaux of Animal Breeding and Genetics, Animal Health, Animal Nutrition, Dairy Science and Technology, Forestry, Helminthology, Horticulture and Plantation Crops, Pastures and Field Crops, Plant Breeding and Genetics, and Soils.

The Institutes carry out the same tasks as the various Bureaux, but, in addition, work on the identification and classification of insects, fungi and parasites useful to man. The task of the Commonwealth Agricultural Bureaux is to discover and summarise new developments and research from all over the world and put them at the disposal of its clients, officially the agricultural and horticultural scientists of the Commonwealth, but actually those interested anywhere who read English.

Each Bureau is attached to a research station or laboratory in the same field; this keeps the Bureau staffs in touch with people and opinion in their subject and gives them easy access to expert advice. The Commonwealth Bureau of Horticulture and Plantation Crops, for instance, is attached to East Malling Research Station and the Director of the station is Consultant Director of the Bureau. Visitors to the station often visit the Bureau, and vice versa.

Progress in agriculture, as in anything else, depends on free exchange of ideas and the results of research work. Many people contribute to this exchange, ranging from the progressive farmer to the research worker in his laboratory, but the exchange is not automatic; it requires the combined efforts of many people.

The main work of this Bureau is the quarterly publication of *Horticultural Abstracts*, compiled from world literature on temperate and tropical fruits, vegetables, ornamentals and plantation crops. Excellent annual and 5-year indexes make it possible to find all information bearing on a problem since the start of publication in 1931. To make the summaries or abstracts, 700-odd periodicals are read and items abstracted. New books, pamphlets, research reports and bulletins are abstracted or noted. The staff of the Bureau can read most of the languages used in scientific publishing.

The title *Horticultural Abstracts* is perhaps misleadingly short, but it reflects the history of the Bureau. Originally concerned only with fruit, it gradually took responsibility for vegetables, ornamentals, citrus, tea, rubber, oil palm, sugar-cane, olives, tung, coconuts, coffee, cacao, tobacco and drug, spice, essential oil and insecticide plants. *Field Crop Abstracts*, prepared by the Commonwealth Bureau of Pastures and Field Crops attached to the Grassland Research Institute at Hurley, Berks, deals with cereal, root and fibre crops, sesame, linseed, sunflower and rape among oil crops, and cowpeas, soya, groundnuts, peas, beans, lupins and lentils among legumes.

The staffs of the two Bureaux include experts on tropical agriculture. Each has an 'official correspondent' in every independent country and the principal colonies, and maintains numerous contacts.

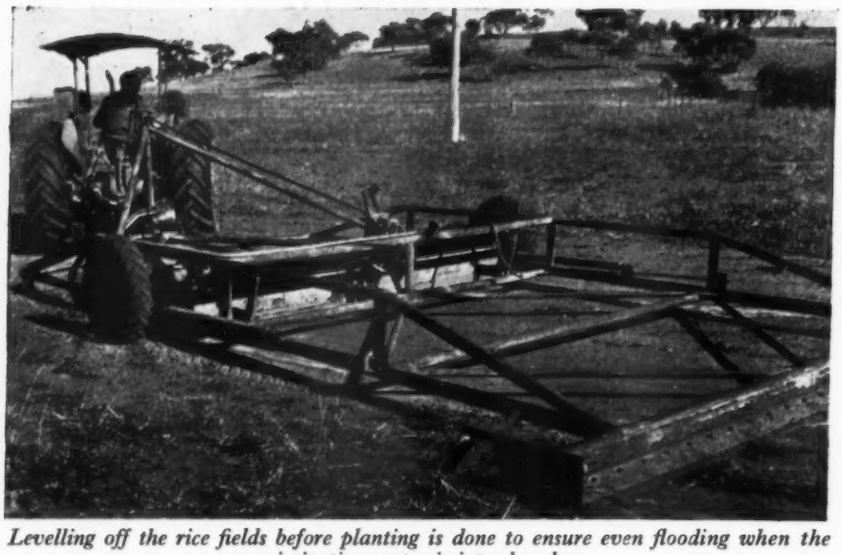
Enquiries may be sent in to the Bureau and the various Institutes, and other useful services include putting research workers in touch with others having similar interests, arranging meetings between scientists in different parts of the Commonwealth, and arranging for the transmission of plant material, cultures and other experimental material.

Finally, each Bureau issues *Technical Communications*, which deal with special problems usually of current interest, often written by rising scientists not on the Bureau staff.

All publications, including recent monographs, are obtainable from the Commonwealth Agricultural Bureaux Central Sales Branch, Farnham Royal, Bucks, England, which will send a full list on application.

Mechanised Cultivation of Rice in Australia

L. HALL



Levelling off the rice fields before planting is done to ensure even flooding when the irrigation water is introduced

The Murrumbidgee Irrigation Area is Australia's largest rice-growing area and perhaps the most highly mechanised rice - growing region in the world. Machines do most of the work – treating, preparing and planting the seed bed, harvesting, drying and bulk handling the grain and finally aerating and packaging it.

AUSTRALIA'S 'rice bowl' – the Murrumbidgee area of New South Wales – was once an infertile waste which scarcely grew grass. This season it has produced a record crop of some 115,000 tons from 30,000 acres – 9,000 tons more than in the preceding year.

Since the area was first irrigated in 1920 the farms have produced products worth £100 million. Production is steadily increasing and last year alone the crop was worth more than £8 million.

In recent years, too, this area has set world records for yields. The average yield is now nearly four tons per acre and some farmers have obtained more than four. Research at the experimental stations in the area aims to increase yields still further and at the same time to improve the quality of the grain.

Yet the N.S.W. Water Conservation and Irrigation Commission found it difficult at first to convince hesitant farmers that this might prove a worthwhile crop. Eventually in 1924 six were induced to sow a trial area of 100 acres between them after they had been promised a guaranteed price for their crop and agricultural instructors were sent to help them.

To their surprise, they harvested good crops, so next season the area was increased, and again the crop was encouraging. The third year it was decided to expand the planted area to 5,000 acres, and this crop was worth £50,000 to the struggling farmers.

The following year the acreage was doubled and the State Parliament was told that a new industry had been established. Expansion was rapid and the original band of six has now become a thousand. The population of the entire 600 square miles was less than 300 in 1924; today it is 30,000 and still growing.

The vital factor

The most important factor in this pattern of success was, of course, water. Hundreds of miles of canals now criss-cross the area and the water

Interior of a large rice store showing the pipes arranged horizontally and heaps of rice forming as the grain is blown out under pressure. The pipes are large cylinders of mesh covered with a light cloth which permits air to pass, but not the rice

An Australian farmer guiding a gigantic combine harvester through a field of paddy. Every few minutes tractor-drawn trailers come alongside and the cleaned grain is off-loaded through the auger arm, seen jutting out

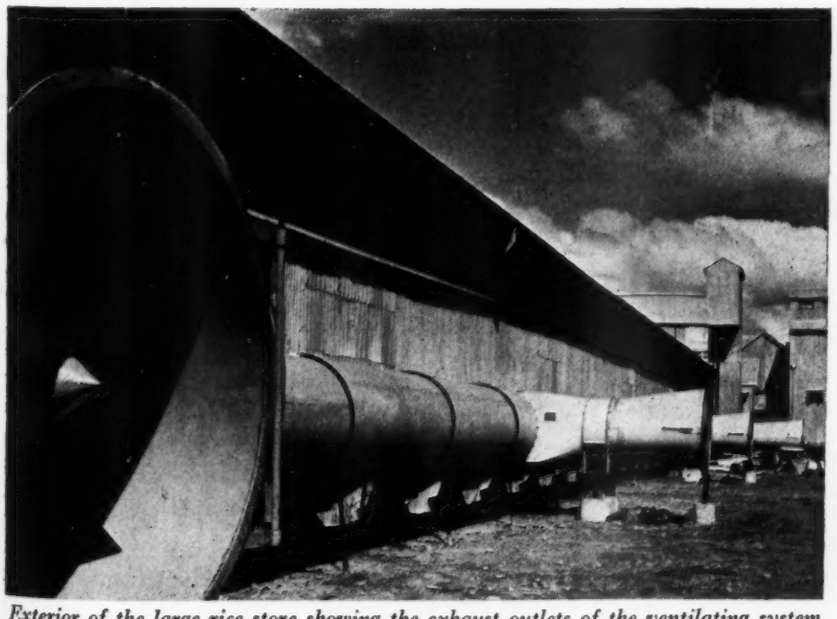
supplies are ample. To check wastage the water is measured by Dethridge water wheels, which are small paddle wheels installed at every junction where the water from the canal enters a farmer's land.

The supply of irrigation water is controlled. As soon as growth shows above the ground, water is allowed on to the land; the water level is gradually adjusted to be just below the level of the tops of the plants until they reach a height of 12 in. The rice ultimately reaches a height of about 4 ft.

The second factor

Another factor in this success story is the high degree of mechanisation, for most of the work from preparing and manuring the seedbed, planting the seed, harvesting, bulk handling and processing and packaging the grain is done by machines. Aircraft are being increasingly used for sowing the seed and applying fertilisers and insecticides. This has resulted in economy, efficiency and low-cost production.

Giant combines, needing only one man to control them, can harvest up to 675 bushels an hour. As these Australian - made machines pass through the crop, standing about 4 ft. high, they cut, thresh and collect the grain. Every few minutes a tractor and its attendant tank trailer swing in beside the combine harvester and the grain is lifted by an auger from the bin and delivered into the bulk trailer. A shuttle service is maintained continuously between the harvester and giant tanker lorries waiting at the roadside to take the grain from the field to the rice stores. The fields are indeed a scene of production line activity.



Exterior of the large rice store showing the exhaust outlets of the ventilating system which controls the moisture content of the rice, so preventing cracking and other deterioration

The third factor

The third factor is the treatment of the grain in storage. The tanker lorries empty their loads into hoppers, the grain is lifted by vacuum, delivered into the rice store and discharged as a spray under pressure from jets high up near the roof. The rice forms great heaps over a system of

ventilation shafts and pipes arranged either vertically or horizontally. The air tubes are of wire mesh covered by a light cloth. This allows forced air to percolate through the rice and carry away the excess moisture.

This is a most important operation, for if the moisture content of the grain is not quickly brought to the correct level the grains are liable to crack. With this system very little rice spoilage and deterioration can occur from this cause.

The raw paddy is allocated to various mills, the bulk of the supplies going to growers' co-operatives, which process and package the rice which is marketed through a grower-elected body – the Rice Marketing Board of N.S.W. – and sent to all parts of Australia and countries overseas.

The whole presents a complete picture of a successful new agricultural industry and from the sowing to the final packaging for home and overseas sale the process is smooth, ordered and efficient.

The Machine in Tropical Agriculture—2

(*Continued from page* 356)

which they claim gives higher yields than with transplanting, is the direct sowing of the crops in rows between rows of maturing wheat in double-cropped fields or on freshly tilled land, thus enabling weed control to be achieved by intercultivation.

One can now appreciate why the tractor has so far not been in very great demand in the tropical countries for cultivation purposes. The areas on which conditions are suitable or can be made suitable for the tractor to operate are very few.

Swamp areas

In some countries of the East the tractor has found a limited use to supplement, or as a replacement of, buffalo tillage and threshing operations. But these cannot really be credited as being of much success, since most paddy lands are within the two-monsoon and 'D' type category, in which the tractor spends more time getting out of the bog than in performing useful tillage operations.

Although it has limited use in the one-monsoon areas for operation in the 'C' type, the average daily output of a tractor is so low as to be quite uneconomic except under a Government subsidised scheme.

Certainly if irrigation can be controlled, and there is no chance of rain upsetting a cultivation programme, cultivation with the tractor and range of machinery similar to those used for wheat is quite possible. This has already been done in the rice-growing areas of Europe, the U.S.A. and Australia, where irrigation is, in almost every instance, provided by the melting of snows in the mountains and flows in rivers to the plains on which the paddy is grown. Unfortunately, such ideal conditions do not prevail in these countries where rice is in greatest demand.

Improved Rice Production in Burma

Rice is the most important commodity produced in Burma, for it earns about 80% of the country's foreign exchange. In recent years, although more rice has been cultivated by Burmese farmers, with a consequent increase in production and exports, earnings have declined. Thus between 1951 and 1957, while exports increased by 40%, actual earnings increased by only 10%.

In 1956 FAO sent Dr. B. R. Sen, an authority on marketing in India, to serve as a marketing adviser to the Government. His first step was to make a village-to-village sampling survey of the paddy-producing areas with the help of the Government's marketing staff. A study of the 500 paddy samples he collected revealed that there were great disparities in the size and quality of paddy produced in the various villages and that this unevenness was responsible for a very high percentage of broken grains.

With the support of the Government, Dr. Sen planned a pilot project to introduce improved and selected seed distribution, grade the harvested grain and store it according to grade; this involved the distribution of one million baskets of pure strain paddy seed, worth about £200,000 in 1958–59.

It is too early to report on the results of this project, but there is no doubt that more widespread use of pure strain paddy must lead to a better and more even quality of rice when the distribution of pure seed is extended to the main rice-producing areas of the country.

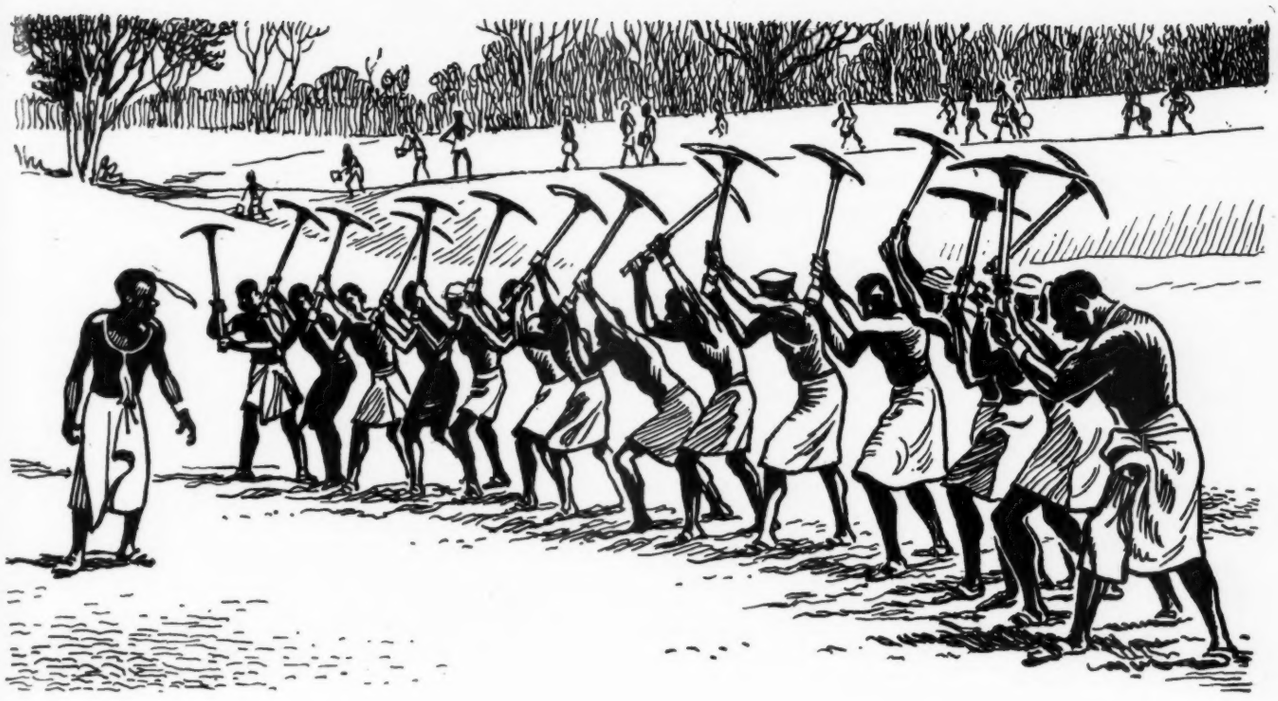
Conditioned Seed

During a recent Conversazione at the Royal Society, Dr. A. Durrant, of the Institute of Rural Science, Aberystwyth, made the following astonishing statement:

Experiments carried out over the last six years show that differences between groups of flax plants, produced by applying different combinations of fertilisers, are transmitted to their progeny and remain undiminished for several generations. In the fourth generation, for example, some groups of plants are still three or four times the size of others. The magnitude of the response varies according to the past history of the seed, the strain used and the season.

A preliminary account of Dr. Durrant's work, carried out over a number of years and aided by a grant from the Agricultural Research Council, appeared in *Nature*, Vol. 181, 29 March, 1958.

High concentrations of the fertilisers NPK were applied to seedlings in boxes in a greenhouse and to the transplants in the field, but not in a concentration to cause damage to the plants. The changes envisaged do not concern an ordinary mutation, gene mutation, chromosome change or structural change, but cytoplasmic factors in the nucleus may be responsible for quantitative variation. That such may take place and be inherited through the seed must require far more experimental work and careful analysis and interpretation. Then it would be interesting to discover what other plants and crops might be affected in a similar fashion.



The Oldest Implement

Evolution of the Rotary Hoe

THE Wakamba workmen seen above are building a catchment bund or low dam. Their countryside has few streams and they depend on man-made pools to collect the precious rain.

They toil in a single line, almost like a human rotor, bodies twisting and arms swinging in time with the chant of their leader. The rough-made blades of their primitive implements sweep down and bite the arid ground.

This is 20th-century Africa, but all this might well have been a thousand years and more ago. For the Wakamba, rhythmically swinging their mattock hoes as their fathers and forefathers swung them, are using the oldest of all farm implements – the mattock or hoe.

The hoe has persisted since time immemorial and its use is illustrated in the murals of ancient Egypt. The woodcuts of medieval times, too, showed the peasant with his hoe, and much later Millet, the famous painter of the French countryside, caught on canvas 'The Man with a Hoe' – a weary, utterly worn-out man who straightens himself for a moment to breathe.

The change to mechanical power came about 1865, when John Fowlers began steam-ploughing, using two sets of multiple-furrow ploughs. The worst feature of this implement was that it tempted farmers to plough to excessive depths and bury the valuable topsoil.

A tractor-drawn Howard rotary cultivator preparing a seedbed

It seems strange today that man did not try much earlier to devise some form of rotating soil mover. The fact remains, however, that nothing was done until quite recent times. It was in 1910, on a New South Wales farm, that a young engineering apprentice, A. C. Howard, stood watching his father's steam tractor. This cumbersome and primitive machine fascinated him, but he observed that much of its power was wasted to obtain the necessary grip to draw the plough. Surely, he thought, some form of rotary cultivator could use this lost power, and so was born the idea of rotary cultivation.

In the years that followed he developed various kinds of rotary hoes, some self-propelled and some larger models for attachment to tractors – mechanical hoes for the smallholder, for orchard and vineyard work, for cultivating the wet paddy fields of Siam, for work in the canefields and among bush crops and tea, coffee or cocoa plantations and even for the reclamation of scrubland.

One Farm, One Tractor

An analysis made recently by the Australian Bureau of Agricultural Economics has shown that a large majority, probably about 75%, of Australian farms have at least one tractor.

The analysis also shows that sales of tractors have now levelled off at about 15,000–16,000 a year, compared with a peak sale in 1950–51 of about 30,000. The total number of tractors on Australian farms at 31 March, 1958 (latest figure available), was about 224,000.

Other points made in the analysis are:

The demand for tractors is to an increasing extent becoming a replacement one, but, as many farmers keep old tractors even after they have bought new ones, the total on farms is still increasing rapidly, and the average age of the tractor is tending to increase.

The sharp peak in sales between 1949 and 1952 has produced an uneven age distribution and will produce a surge in replacement demand when those tractors reach the end of their working lives, probably within the next five years.

There is a strong trend towards the use of high-powered tractors, particularly in the case of wheeled tractors, and also towards the use of diesel fuel rather than kerosene or petrol. At present nearly 80% of all tractors sold are powered by diesel fuel, compared with just over 50% three or four years ago and a much lower percentage 10 years ago.

The increase in power, together with technological developments in the farm machinery field, has made an increasing range of new methods available to farmers and greatly increased flexibility in farm management.

Agricultural Education

The new National College of Agricultural Engineering will be quite a separate entity from the National Institute of Agricultural Engineering, but will naturally retain close connections with the Institute. Each will have its own governing body and will be administered quite independently.

The method of protecting the sugar-beet seedlings with a row of shielding plants

Accelerated Seed Production

The Sopron-Horpacs Research Institute in Hungary is mainly concerned with the development of new varieties of sugar-beet. To obtain the seeds of a new cultivar, however, is a lengthy operation, as it takes two years to obtain seed – in the first year the roots are produced and these must be planted early in the spring to ensure seeding in the summer. This is not always possible owing to bad weather.

The Institute has developed methods to ensure earlier seeding. One is to leave the roots in the soil over winter and, in order to protect the rows from snow and cold, they plant between them a shielding plant, preferably flax. The undisturbed roots produce their seeds much earlier and they are of better quality.

Another method of producing new varieties every year is by the practice of vernalisation. The seeds are sown in summer, preferably after the wheat harvest, and the young plants are lifted in the autumn and stored in pits. Replanted in spring, they are already producing seed in the summer and so it is possible to produce new varieties regularly each year.

Technical News

Articles in the October issues of some of the other journals of the Leonard Hill Technical Group include the following:

Chemical & Process Engineering. – ' Design and Organisation of a Chemical Project ' by W. Fletcher; ' Chinese Progress in Atomic Science ' by R. Westgate.

Dairy Engineering. – ' High Temperature Treatment of Milk ' by Profs. C. W. Hall, PH.D., and G. M. Trout, PH.D.; ' Preview of the Dairy Show '.

Fibres & Plastics. – ' Flammability of Fabrics ' by D. L. Simms; ' Fibres and Plastics for Fire Fighting '.

Manufacturing Chemist. – ' Review of Perfumery and Cosmetic Raw Materials ' by V. Vasic; ' Lemongrass Oil from Ceylon ' by M. G. De Silva.

Petroleum. – ' Air Pollution and the Petroleum Industry '.

Public Works and Muck Shifter. – ' The Nagarjunasagar Project ' by S. Ramanath.

Storage, Transport and Shipment of Cocoa

2—Protection during Handling and Shipment

B. D. POWELL, M.A., PH.D., F.R.I.C., and G. A. R. WOOD, B.A., D.T.A.

Part I gave an account of different methods of protecting cocoa beans during storage. This is an account of experiments carried out in the British Cameroons with polythene liners to prevent moisture absorption during storage and shipment.

IN some cocoa-growing areas it might be possible to export the crop so quickly that the moisture content during the interval between drying and shipment does not have time to reach the critical figure of 8%. Each area needs to be considered individually, bearing in mind the following factors: the crop needs to be dried adequately (though not excessively) on the farm or plantation; the transport conditions between the producing areas and the port; the frequency of shipping; possible delays before shipment due to marketing procedure; and any seasonal variations in cropping.

It is important that the beans should be properly dried by the producer, but this does not mean that they should be over-dried, as this makes them unduly brittle and in consequence more susceptible to insect damage. Bags of dried cocoa beans should also be stacked without delay so as to check moisture uptake, as in a large well-made stack only a small proportion of the bags are exposed. With periodical restacking no bags need remain in the top or side positions all the time.

Sacks with polythene liners

Polythene liners are being increasingly used for the protection of foodstuffs, such as tea, coffee, flour, sugar etc., in order to prevent the uptake of moisture, and there has been no record of any taint resulting from their use. The results of preliminary experiments at Bournville were so encouraging that a quantity was taken to the British Cameroons for further tests under field conditions.

The size of these liners was 30 in. x 60 in., which is a little wider and longer than the twill bags inside which they were each placed. The bag takes the mechanical strains and there is sufficient length of liner to allow it to be tied with string, or folded in, before the bag is sewn. The gauge of the material used for the liners was 150 and 300, the main considerations being effective resistance to the passage of moisture, the strength of the material and its cost.*

Storage trials with lined bags

Trials were carried out at four stores representative of the various conditions between production and shipment: at Kumba, the main buying station; at Ekumbe, a bush buying station; at Mukonje, a small store in an African's hut; and at Bota, the store of the Cocoa Marketing Board on the coast.

Both fully- and under-dried beans were used in these storage trials and the bags were placed separately on scantlings with all faces exposed to the atmosphere. The moisture content of the cocoa was determined at intervals over a period of four or five weeks and the results for the Kumba main store are shown in Fig. 2; the graphs showing the moisture uptake were similar for all the four stores and it was found, too, that the 150- and 300-gauge liners gave much the same results.

These show that the dry cocoa in the lined bags took up only 0.3% moisture in 30 days and that in the unlined bags took up 10 times as much, or 3%, in the same period. Furthermore, the rate of uptake of moisture was greatest in the first three weeks and slower thereafter.

Handling trials

In these tests bags of cocoa beans,

* Cost f.o.b. U.K. port is about 10d. and 1s. 7d. respectively.

Photo: C.O.I. Crown Copyright reserved

It is important that the cocoa beans should be properly dried before bagging them in lined sacks. This is a cocoa-drying central in Equatorial Africa

some with 150-gauge and some with 300-gauge liners, were used; some were closed by tying and some by folding; and the bags so prepared were carried around in a ' Land Rover ' and unloaded and reloaded at various points. Both materials stood up well to handling, the thicker gauge material being rather better than the 150-gauge material, but it was also found that, unless great care was taken, the liners made of the thinner material could be damaged irreparably when the bags are emptied.

Shipping trials

Various parcels of dry cocoa beans were made up after grading – some were bagged without liners, some had the 150-gauge liners, and some the 300-gauge liners; some were closed by tying and some by folding. In addition, some bags, by special permission of the Cocoa Marketing Board, were exempted from check testing by the produce inspectors. This normally involves the removal of beans from the bags by means of a sampling horn on three occasions before export: on the day after grading, on receipt at the port store, and immediately prior to shipment. The sampling horn leaves only small holes in the liner, but it was obviously necessary to determine whether this procedure would affect the moisture uptake in transit.

This consignment of cocoa was shipped from Bota, after storage in large stacks, to Liverpool following the normal procedure for commercial shipments, and on arrival at the factory at Bournville the bags and their contents were examined with the following results:

Moisture uptake: The moisture uptake with the lined bags – both the 150 and the 300 gauge – was negligible. The moisture content of the beans in the unlined bags had risen – those graded 15 weeks previously by about 1.5%, and those 11 weeks previously by 1%. Furthermore, the perforations caused by the check testing did not increase the moisture uptake.

Flavour: Chocolate made from the cocoa, shipped in the lined bags, possessed no taint or flavour, attributable to the use of the polythene liners.

Wear and tear: Of the 300-gauge liners which had not been perforated through check testing, 90% were undamaged after removal from the bags and were suitable for re-use. It was, however, very difficult to recover the 150-gauge liners undamaged. The liners were better folded than when tied with string, and thus it is probable that heat sealing would give even better results.

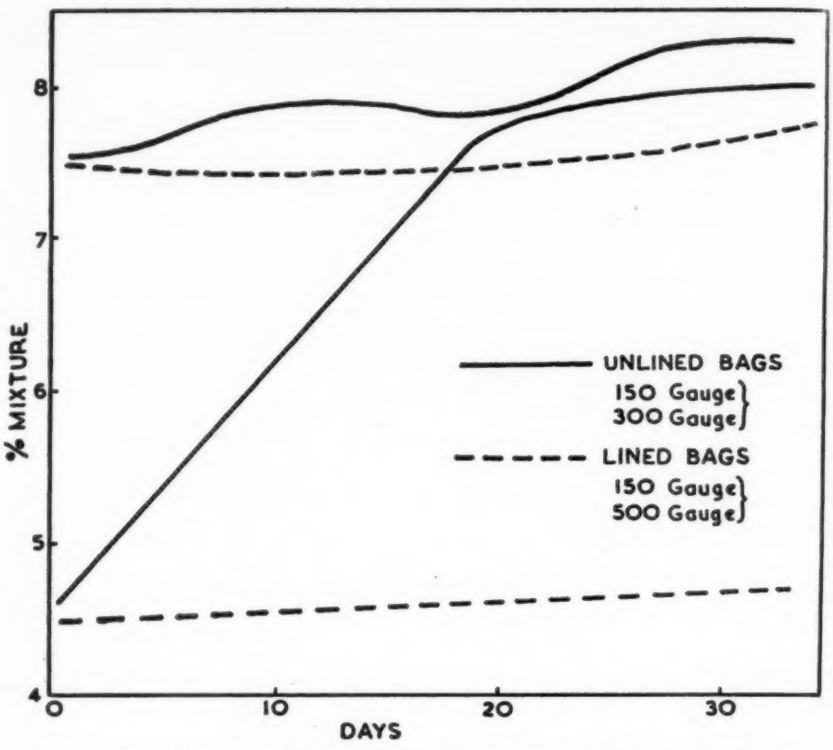


Fig. 2. The effect of storing cocoa beans in lined and unlined bags at Kumba

Conclusions

It was concluded that polythene liners can effectively prevent the uptake of moisture by *dry* cocoa beans, and so also the development of mould; if, however, cocoa beans of good quality, but with a moisture content of 8%, are placed in a lined bag, the development of mould cannot be avoided. Thus all cocoa which is to be put into lined bags must be properly dried to a moisture content of 5% to 6%.

For storage in the country of production it is better to use the thicker 300-gauge liners in the stores in the cocoa areas and in transit to the main grading centre, as they can be used several times. The farmers should place the cocoa into the lined bags immediately after drying, as the storage conditions in their houses are usually poor. Furthermore continuous bad weather might prolong the storage where the product has to be head-loaded; once the beans are in the lined bags such delays would no longer matter and the cocoa would be protected from rain.

For shipment the thinner 150-gauge liners are quite adequate for the protection of the product after it has been graded and until it reaches its ultimate destination. The use of liners would prevent the damage caused by ' sweating ' in the holds and the dropping of condensation water on to the bags; this form of damage can be considerable, particularly during a rough voyage, when the ventilators have to be closed. Obviously, also, their use can prevent damage by rain or sea spray during loading.

Another important consideration is that the use of lined bags will prevent cross-infestation by insect pests, for, although the insects present in a bag will continue their development, they are unlikely to be able to escape and infect other bags in the consignment.

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Polythene Liners

The attention of the reader is specially directed to our report on the Packaging Exhibition which is to be found on page 376 in this issue.

New Publications

Sisal in Tanganyika

An Economic Survey of the Sisal Industry in Tanganyika by C. W. Guillebaud, C.B.E. Pp. 120 + xvi. Foreword by Sir Eldred Hitchcock; summary and statistical appendix. James Nisbet & Co. Ltd., Welwyn, Herts. 15s.

Mr. J. W. F. Rowe, Fellow of Pembroke College, Cambridge, widely known for his studies of primary commodities, states in his introduction that this book is the first comprehensive economic survey of any of the hard fibre industries.

Mr. Guillebaud deals historically with the expansion of the output of the chief hard fibres in world centres of production and, in particular, with the growth of the sisal industry in Tanganyika. In his second chapter he discusses the reasons for price movements and there are numerous tables which clearly indicate the trends of production, consumption, prices and costs in the pre-war, war and post-war periods. Consumption is apparently keeping pace with production, despite considerably increased production, especially in Brazil and Portuguese African territories.

The financing of large-scale production is discussed in Chapter III. The point is made that a short period of abnormally high prices, such as occurred in 1950–51, is not of great advantage, if profits taxes are then imposed, when the industry is seeking to recuperate from previous financial difficulties, modernise its equipment and establish new markets. Depreciation is considerable, particularly in the fertility of the soil over vast areas of land where organic materials are hard to find and too costly to use as manures.

With regard to marketing, he observes that because of the lack of a 'futures' market, when pressure to sell is combined with increased production, there is always a tendency for a buyers' market to develop.

The chapter on labour and employment should interest those engaged in other industries in East Africa. Too often employers refer to the African as indolent. Unreliable he may be, but Africans, on the whole, are as hard working in their environment and in relation to their pay as are the workers in Britain.

Technical Books

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as retail booksellers will be pleased to supply any books reviewed in this periodical, and will give immediate attention to any requirements you may have for other works

The author uses scientific or botanical names, but unfortunately the first paragraph or two are strewn with errors. For instance, Kew lists *Agave sisalana* (spelt with a small s) in the family *Agavaceae*, and henequen is not a variant of sisal, but a separate species.

A. E. HAARER

Forest Machinery

By E. R. Huggard and T. H. Owen. Pp. 192, illus. A. and C. Black, London. 1959. Price 24s.

The U.K., a pioneer in agricultural mechanisation and with the most highly mechanised farming system in the world today, has for several reasons lagged sadly behind in the field of forest mechanisation. However, since the war, with the spur of the labour shortage, the large planting programme of the Forestry Commission, and plantations established before the war now beginning to yield thinnings, there has been a minor revolution in forest mechanisation.

The book is a review of the forest machinery scene in Britain today; indeed, it is significant that it opens with a three-page list of acknowledgments to machinery manufacturers (almost exclusively British) who have provided information and illustrations.

The material is divided for convenience into chapters on nursery equipment, site preparation and planting machinery, road construction plant, felling and rough conversion, extraction, forest protection and ancillary machinery. Economic considerations are not overlooked and an appendix contains useful conversion tables, traction factors etc. There is a concise index.

The authors have avoided the danger of turning the book into a mere catalogue of equipment and have produced a very readable work containing much helpful advice and information and a clear indication of what machinery is available to forest owners, with pointers on factors affecting choice and use.

W. LINNARD

Maladies of Hevea in Malaya

By Roger N. Hilton, with water-colour illustrations by Hoh Choo Chuan. Pp. 101. Rubber Research Institute, Kuala Lumpur, Malaya. 1959. Price Straits $30 (approx. 72s.).

The primary object of this book is to assist planters in Malaya in identifying and correctly treating diseases of the rubber tree caused by injuries of non-parasitic origin. To this end the author concisely describes symptoms, cause, other plants affected, spread, prevention and treatment of 41 maladies.

This large number may seem formidable, but really serious diseases are few and about half of those included in this book are not, strictly speaking, diseases, but physiological defects resulting from faulty nutrition. A disease of little importance at one time may assume epidemic proportions where conditions are particularly favourable for its development. One can remember many instances from one's own experience where serious loss by an estate might have been obviated if the planter had recognised a disease before it became widespread. The comprehensive treatment of the subject in this book is therefore fully justified, for it facilitates early identification of any disease at present known in Malaya, and probably also to be found in most rubber-growing countries.

While acknowledging the skill with which the author has presented the results of research work in Malaya over the past half century, he will probably be the first to acknowledge the debt he owes to his illustrator, Mr. Hoh Choo Chuan, who, one is told, has contributed expert drawings and paintings to the publications of the Institute

for the past 30 years. His present series of 41 full-page plates in colour are accurate and most beautifully executed, and therefore add immensely to the value of this book.

D. H. GRIST

Advances in Agronomy, Volume X

Edited by A. G. Norman. Pp. 332. New York: Academic Press Inc. 1958.

One of the most serious problems facing research workers and teachers is in keeping abreast of recent developments in the sciences, and the situation will become increasingly more difficult. It is physically impossible to wade through even a small fraction of the enormous volume of scientific literature which pours from the world's presses today. With the diversity of languages in which it is published the scientist now faces an insurmountable task. The problem is probably most serious for those working in the applied sciences, such as agriculture or medicine, as it is vital that they keep a broad and balanced view of the whole discipline within which they are specialising.

Two main attacks have been made upon this problem – first by the development of abstracting services. These not only summarise the most important results and ideas from papers, but classify them as well. Comprehensive abstract journals are now an indispensable part of scientific literature. Agriculturists are particularly fortunate in this respect in having at their disposal the series of journals published by the extremely efficient Commonwealth Agricultural Bureaux.

The second line of attack is the review. Abstracting services do not give a comprehensive, integrated picture of a topic – that is not their function. Reviewing is a sort of ' communal reading '. While *A* is searching for material relevant to topic *a*, condensing it, arranging it in a logical fashion and interpreting it, *B* is doing the same for topic *b*. *A*, plus many others, are then able to grasp the essentials of topic *b* in a comparatively short time by reading *B*'s review, and vice versa.

Advances in Agronomy belongs here. Ninety reviews have been published in the first 10 volumes, mostly without overlapping, although rapid advances in knowledge are likely to result in increasing instances of ' revisions ' during the second decade of some papers reviewed in the earlier volumes.

Broadly, the subject matter has been equally apportioned between soils and crop husbandry. This is illustrated by the contents of the present volume. On the one hand, there are discussions of plant nutrient behaviour and fertiliser use; Australian soils and their responses to fertilisers; reactions of ammonia in soils; the role of sulphur in soil fertility; and liming. On the other, there are the following topics: race 15B of wheat stem rust; castor beans; safflower; and new grasses and legumes for soil and water conservation. Covering both aspects are two other articles – one a regional study of agronomic trends and problems in the Great Plains of the U.S.A., the other a study of corn plant population in relation to soil productivity. Ever since the series started the interdependence of crops and soils has been emphasised by virtually all the authors concerned.

Advances in Agronomy does ' indeed advance the whole profession '. It is a venture which all agriculturists hope will continue to give service for many more decades.

A. W. MOORE

Reports and Bulletins

Pasture Improvement in the Pillaga, Report No. 3, December 1958, and *The Commercial Use of Nitrogenous Fertilisers and Autumn Sown Oats for the Production of Winter Dairy Forage*, Report No. 4, June 1959. University of Sydney, School of Agriculture, New South Wales. Prices not stated.

The Economics of Padi Production in North Malaya. Part 1. Land Tenure, Rents, Land Use and Fragmentation, by T. B. Wilson, M.A., DIP.AG.ECON., D.T.A. Bulletin No. 103 of the Department of Agriculture, Kuala Lumpur, Federation of Malaya, June 1958. Price $3 or 7*s*.

Report of a Conference on Herbage Seed Production, November 1958. National Institute of Agricultural Botany, Huntingdon Road, Cambridge. Price 8*s*.

Soil and Land-Use Surveys: No. 1, Jamaica, Parish of St. Catherine, March 1958; price 20*s*. No. 2, British Guiana, the Rupununi Savannas, March 1958; price 15*s*. No. 3, St. Vincent, December 1958; price 25*s*. No. 4, Jamaica, Parish of St. Andrew, February 1959; price 12*s*. 6*d*. No. 5, British Guiana, the Mahdia Valley, the Bartica Triangle, the Kamarang and Kukui Valleys and part of the upper Mazaruni Valley, April 1959; price 14*s*. Publishers: Imperial College of Tropical Agriculture, Trinidad, West Indies.

Prospects of Cocoa Growing in Uganda and Zanzibar, 1958, and *Report on an Investigation into the Prospects for Growing Cocoa and Oil Palms in India*, 1959. Reports by D. H. Urquhart. Prepared for and published by Cadbury Brothers Ltd., Bournville, England. Price 5*s*. each.

The New Orchard. Bulletin No. 528, February 1959. Ontario Department of Agriculture, Parliament Buildings, Toronto, Ontario, Canada. Price not stated.

The Bulk Harvesting of Orchard Fruit, by G. E. Tidbury. Digest No. 1, Commonwealth Agricultural Bureaux, Central Sales, Farnham Royal, Bucks, England. Price 5*s*.

Using Low-Volume Farm Sprayers, Circular 126, January 1959, and *Mechanised Cotton Production in Alabama*, Circular 127, January 1959. Alabama Polytechnic Institute, Auburn, Alabama, U.S.A. Prices not stated.

Horticulture in the British Commonwealth, by D. Akenhead, O.B.E., M.A., B.SC. Technical Communication No. 26 of the Commonwealth Bureau of Horticulture and Plantation Crops. Published by the Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, 1958. Price 10*s*.

FAO Publications

World Crop Harvest Calendar, 1959. Price $3 or 15*s*.

Trade Yearbook, Vol. 12, 1958. Obtainable from H.M. Stationery Office. Price 17*s*. 6*d*.

Yearbook of Forest Products Statistics, 1958. Obtainable from H.M. Stationery Office. Price 12*s*. 6*d*.

Food and Agricultural Price Policies in Asia and the Far East, 1958. Price $1.25.

Tabulated Information on Tropical and Subtropical Grain Legumes. Plant Protection and Production Division, FAO. 1959. Price $3.50 or 17*s*. 6*d*.

Production Yearbook, 1958, Vol. 12. Price $4.50 or 22*s*. 6*d*.

An 8-row cultivator attached to a ' Farmall ' tractor passing through a field of maize

Machinery and Equipment

Eight-row Farming

With a changing agricultural picture – larger farms and a dwindling supply of labour—big acreages can be worked more quickly, more efficiently and at lower cost by 8-row farming. The *International Harvester Export Co.*, of the U.S.A., have produced an 8-row cultivator, which can also be used as an 8-row planter by fitting the appropriate seeding units to the toolbar. The machine is as easy to handle as a 4-row model and does double the work.

The main cultivator 4-row frame covers four 3-ft. rows, and there are two outer frames, which are hinged to the main frame, each working over two rows. The unit can thus be folded for easy transport along the road and for convenient storage. The operator can also, by selective hydraulic control, lift the two outer gangs, either separately or at the same time. Both are kept at an accurate level by two pneumatically - tyred wheels, at the extreme ends of the toolbar.

Maize for Silage

A new attachment makes it possible for the *Lundell* forage harvester to be used in tall, heavy crops, such as maize and sorghum. It is fitted to the front of the machine and guides the maize stalks into the cutting cylinder, where the knives cut and chop the crop and deliver the mixed material into a trailer, which can either be offset or drawn behind the forage harvester. The degree of laceration of the cobs, leaves and stalks is controllable and the device provides a palatable and nutritious feed, which packs well in the silo.

Power Tool

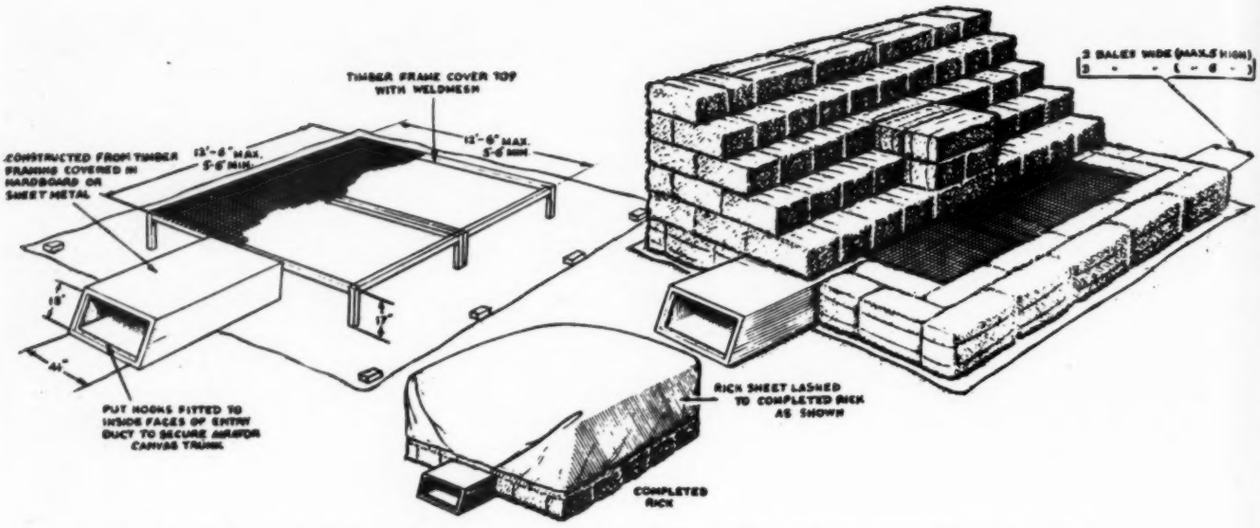
A new power tool to be used as a ' Gardenmaster ' attachment or on any portable electric drill has been developed by *Simmonds Aerocessories Ltd.* The ' Surcut ' is a 5-in. dia. perforated cutter which will remove paint and varnish without clogging and will shape wood, composition materials and non-ferrous metals. It gives a fine finish which needs no further smoothing. It is described as ' the ideal tool for use on nailed boards and decking, as it will take nail heads in its stride '.

The cutter is a disk of unbreakable case-hardened steel, which is set with 108 teeth, arranged in tangential lines of three teeth. There is a clearance hole in front of each tooth, through which the swarf can pass to the back of the disk, whence it is discharged away from the operator. The tool is easy to control and is claimed to be very much safer than the usual power cutting tools and abrasives.

The maize attachment for the Lundell Super ' 60 ' forage harvester

Cooler Tyres

A new advance in tyre construction, combining the recently developed X-99 tread rubber with a ' Tyrex ' cord body, is claimed by the *Firestone Tyre & Rubber Co.* to give 15% more wear, greater strength and a smoother and quieter ride, reducing corner squeal to a minimum. The new cord is much stronger than the rayon cord previously used and this, with a reduction in bulk, makes it possible to produce a safer, lighter and cooler-running tyre.


TIMBER FRAME COVER TOP WITH WELDMESH
CONSTRUCTED FROM TIMBER FRAMING COVERED IN HARDBOARD OR SHEET METAL
12'-6" MAX.
5'-6" MIN.
18"
17"
44"
PUT HOOKS FITTED TO INSIDE FACES OF ENTRY DUCT TO SECURE AIRATOR CANVAS TRUNK
RICK SHEET LASHED TO COMPLETED RICK AS SHOWN
COMPLETED RICK

Open-stack drying. Diagram showing how the stack is built on a timber frame covered with wire mesh

Artificial Drying

It was a very dry summer this year in Britain; next year may be an equally wet one. It is best to be prepared to dry the hay crop. Two new methods of hay drying were recently demonstrated using the *Trojan* 'Airator' – a mobile oil-fired fan and heater unit – to dry bales of hay with a moisture content of about 50% down to 15%.

Open Stack Drying. A 10-ton stack made up of some 250 bales was built around a raised ventilated floor of wire frames; the bottom layer of bales were arranged with their strings pointing to the middle and the five subsequent layers had the cut edges pointing out. A canvas rick sheet covered the top, so that the air introduced by the 'Airator', was forced to escape through the sides of the stack.

After 12 hours blowing cold air, the heat was turned on for 60 hours with a final six hours cold blow to cool down the stack and prevent it from re-absorbing moisture. The total drying time was thus 78 hours.

Enclosed Bin Drying. A prefabricated bin consisting of 18 wooden panels, enclosing an area 15 ft. x 20 ft., was built inside a Dutch barn. About 400 bales were arranged in six layers on a raised ventilated floor inside the bin. Air introduced by the 'Airator' passed up through the stack and out of the open top; none was wasted because the wooden panels provided an airtight seal. The total drying time in this case was 55 hours.

Lifetime-Lubrication

Lifetime-lubricated track rollers, carrier rollers and idlers, now standard on the new D9 tractor, represent a significant step forward in the development of the *Caterpillar* tractor, for it is no longer necessary to do any field lubrication and the machines are available for continuous operation, so giving lower maintenance costs and savings in man-hours and materials.

The new rollers and idlers have now been tested under operational conditions for more than three million hours on 150 machines under conditions which required them to work in water, sand, rock, gumbo, coral and frozen clay and in some projects to work round the clock for six days a week and, in another, under continuous shock conditions over a rocky road.

These severe tests have proved that the new rollers and idlers effectively keep out dirt, hold the lubricant,

The Salopian-Huard reversible plough in action, showing the pattern of the furrows

rotate easily, wear longer and have a greater load-carrying capacity.

Reverse Ploughing

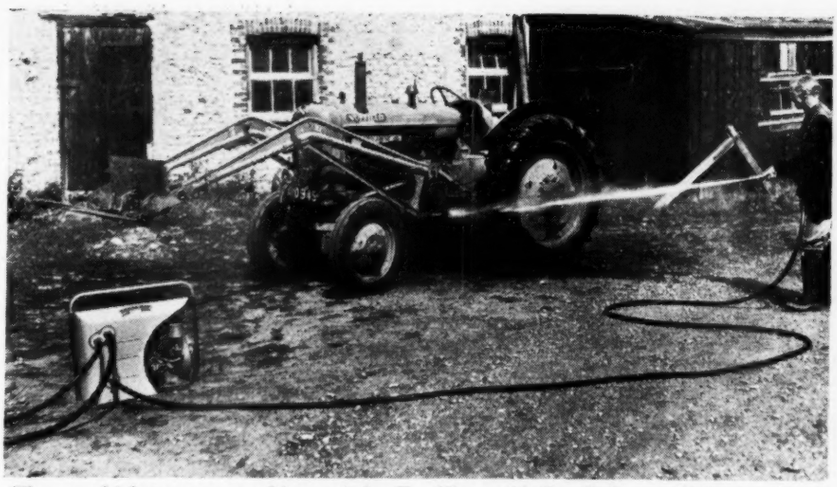
The *Salopian - Huard* reversible plough is a rear-mounted assembly of twin ploughs which can be automatically reversed when the tractor reverses its direction at the end of each row, so that the pattern can be maintained. The implement can be considered in two parts. The fore-carriage is connected to the tractor linkage and carries the operating mechanism; the rear-carriage consists of a heavy beam, which carries four mouldboard ploughs and two disk coulters, and is housed at one end on two roller bearings within the housing of the fore-carriage. A safety device in the rear-carriage fractures when abnormal resistance is met during ploughing. A 25/35-h.p. tractor is required, according to the soil conditions.

A deflector-hood made of reinforced canvas as fitted to the 'Hurricane' forage harvester

Pumps for all Purposes

F. E. Myers & Bro. Co., of U.S.A. and Canada, are manufacturers of single-stage and 2-stage shallow or deep well pumps in small units, requiring from ½ h.p. up to 1½ h.p., according to the lift, the pressure at delivery and the capacity required. Each includes pump and motor, a pressure - regulating valve, pressure switch, pressure gauge and air control incorporated in one compact unit.

One of these, the 'HCM Medallist', is a dual impeller, which will prime easily under shallow well conditions and is designed to give plenty of water under pressure even from wells as deep as 150 ft. Their new pump catalogue shows that these pumps will deliver up to 1,260 g.p.h. at pressures of up to 80 lb., according to h.p.



The new high-pressure washing unit by E. Allman & Co. Ltd. can deliver a jet of water at 400 lb./sq. in.

Ploughing and Cultivation

The movement of tractors and heavy farm vehicles over land tends to produce a 'hard pan' in the soil, which seriously checks the movement of moisture upwards during dry spells and so could lead to reduced yields. The 'Ploughrater' is a new invention which enables the farmer to plough and cultivate in one operation, and thus saves the unnecessary movement of the tractor over the land. By ploughing and ploughrating in one operation there is no need to depend on frost to break up the clods; it will be easier and better to wait for the spring, when the ground is in good condition for both operations in one passage of the tractor.

The cultivating unit is built on a twin plough assembly. When the chock* turns on the mouldboard the rapidly rotating tines of the 'Ploughrater', driven from the p.t.-o., chop up the top of the furrow and throw the stubble, weeds, grass or manure to the bottom of the clear furrow. The remainder of the underlying soil is then broken up and thrown at seedbed tilth over the chopped vegetation. The device helps itself along by the forward movement of the tines; the plough loosens the soil and allows the tines to chop more easily and the second plough makes easy work of turning the cultivated soil. Thus the whole operation is easier than might be imagined.

The ultimate object is to produce a seedbed ready for immediate planting, so this tool should be used in spring when the conditions are most suitable. Further particulars may be obtained from *William Hooton Ltd.*, who are the manufacturers.

* Wedge of soil

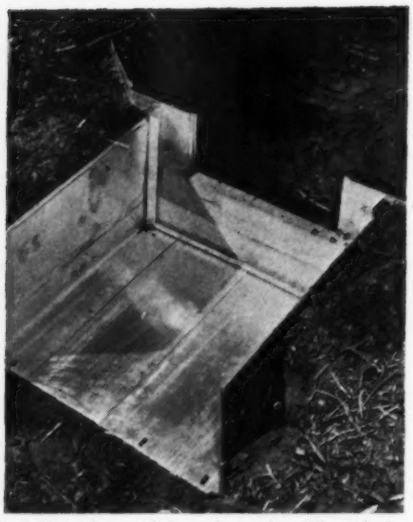
Haymaking Attachment

Harrison, McGregor & Guest Ltd. are offering a useful attachment to fit to the deflector hood of the *David Brown* 'Hurricane' harvester. It is a circular chute of reinforced canvas, which guides the cut material on to an angled deflector plate and deposits it as a swath approximately 2 ft. wide. The driver can direct the cut swath either to the right or left of the harvester, according to the direction of travel. This allows ample distance between swaths for the tractor to work without running over the cut crop on its next run in the reverse direction.

Washing Farm Machinery

A new high-pressure washing unit designed by *E. Allman & Co. Ltd.* can deliver a jet of water at 400 lb./sq. in. and the jet can be cut down to a fine mist; a return hose then allows the surplus water to be returned to source, thus conserving the supply. Each unit is equipped with 30 ft. of ⅜-in. delivery hose, 15 ft. of suction hose and 15 ft. of return hose. Working at top pressure, the water consumption is 3½ gal./min.

The compact unit consists of a twin-cylinder pump with special liners made of a special ceramic which cannot be damaged by abrasive materials. The pump is driven by a 2½-h.p. 4-stroke



The aluminium sides of the ' Porta-Plank Irri-Gate ' are driven into the sides of the ditch and it is closed by the rigid aluminium spillway, which is bolted on to the side members

air-cooled petrol engine fitted with a 6:1 reduction gearbox.

Submersible Pumps

In the June issue of WORLD CROPS, page 215, there appeared an illustration of a *Beresford* submersible pump of their A11 range, which can be supplied for capacities from 400 to 600 gal. per hour, according to the head; pumps with more stages can be supplied for heads up to 700 ft. This firm also makes units of larger capacity for boreholes with inside diameters of from 4 in. and upwards and with capacities of up to 110,000 gal. per hour and for heads of up to 1,200 ft. Motors are in sizes ranging from 0.5 up to 165 b.h.p.

Farmyard Manure Spreader

The new *Wallace* A.V.3 ' Major ' farmyard manure spreader has a capacity of 70 cwt. It has an overall length of 15 ft. 11 in. and an overall width of 6 ft. 8 in. and is carried on oversize 9.00 x 13 tyres; brakes can be fitted if ordered. Attachments, such as a swing-up tailboard, a root-unloading elevator, silage sides and a lime spreader, can also be supplied as extras.

4-in-1 Versatility

The versatility of the *Templewood* ' Multi-Culta ' lies in the number of operations which it can perform either separately or simultaneously – drilling, hoeing, fertiliser placement and down-the-row thinning, so saving tractor time, fuel, labour, crop damage and the unnecessary movement over the land.

The implement is a semi-mounted unit to which the parts required for each operation are attached. Only one bolt is needed to fix each head. With the standard toolbar up to four 14-in. to 20-in. rows can be worked simultaneously. There is also a longer toolbar to take six working heads.

It can be used for a variety of crops and is exact in its operation, owing much of its precision to the land drive conveyed by its broad non-slip cage wheels, which eliminates the variation in spacing sometimes found with p.t.-o. driven machines.

Irrigation Control

Open-ditch irrigation is still the most widely used method of distributing water over land, but control is not always satisfactory, leading to wastage of water and waterlogging.

The ' Porta Plank Irri-Gate ' is a water-control box, manufactured by *Wesco Products Corporation* from aluminium produced by *Kaiser Aluminium & Chemical Sales Inc.* This water gate is an assembly of interlocking, 8-in. wide aluminium sheets bolted to a rigid aluminium spill-way, all joints being rigid and watertight.

It can be installed as easily in running water as in a dry ditch and the parts are so light that the material for one unit can easily be carried under one arm. The time taken to fit one of these boxes ranges from 15 min. to 1 hr. and the unit can be quickly dismantled and moved elsewhere.

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Eden Street, London, N.W.1,
England

The Templewood 4-purpose ' Multi-Culta ' seen in operation as a fertiliser placer, a cultivator and a down-the-row thinner

Agricultural Chemicals and Supplies

Cereal Seed Classification

Dunns Farm Seeds Ltd. have enlarged their seed storage space for their G-Seed Scheme and now have a warehouse to hold some 1,000 tons of traded seed corn which is to be handled mechanically.

Terms hitherto used to describe cereal seeds have so often been meaningless, for under existing certification schemes tenth generation seed might still be sold under the same banner as the one produced direct from breeders' seed.

The starting-off point in the G-Seed Scheme is nucleus seed from the breeder, designated A1. The first produce of this seed (the growing crop is checked at all stages to ensure maximum varietal purity) is known as G1 and it serves the grower who wishes to dispose of the produce of the crop for seed again.

The next generation (the second from A1) is known as G2. This generation also is produced under high inspection standards and crops are eligible for inspection under cereal field approval schemes so long as the variety itself is eligible under the scheme.

The third generation is known as G3. Again it is produced under rigid field inspection and it is designed to meet the need of the grower who requires authentic seed, but who disposes of his crop for milling purposes only and not as seed. So far as the G-Seed Scheme is concerned, multiplication for seed purposes is not pursued beyond the third generation.

Water Conservation and Weed Control

Tests at the University of California have indicated that black polyethylene ditch liners will reduce seepage by as much as 94%, particularly where the channels are cut through the more open-textured soils. Other advantages which naturally follow are weed control and the protection of the banks from erosion, and, in consequence, there will be less silting up of the ditch bottoms. The average rate for preparing and lining a ditch is 80 ft. per man-hour.

The material is offered by the *Union Carbide Plastics Co.* in three thicknesses, 1.5 mil, 4 mil and 8 mil. It was tried out on 22 sites over a period of three years, the sites providing the varying conditions of soil, soil management and climate needed to test the material thoroughly.

A ditch, partly lined with polyethylene film, showing how the weeds in the foreground act as an effective brake on the smooth flow of water

For most conditions 4 mil and 8 mil film can be expected to perform satisfactorily for three years or more. The 1.5-mil film is serviceable for one year with careful handling. If a liner should become damaged by animals, shovel cuts or rips, it can easily be repaired with pressure-sensitive tape.

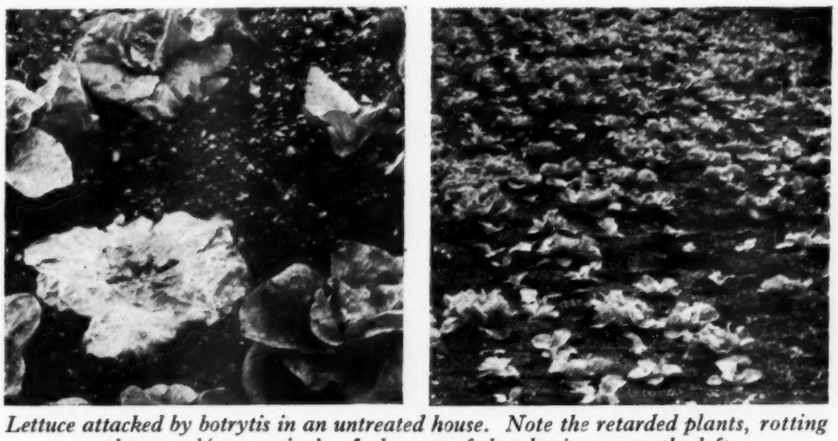
All three thicknesses of film were found to be effective for controlling weed growth. Bermuda and water grass were virtually eliminated, but where nutgrass is a problem the two thicker films are recommended.

Another not so obvious advantage in using this material is that friction losses are reduced because of the smoothness of the film. Because of this it is possible to decrease the cross-sectional area of the ditch by about one-third, without reducing the rate of flow.

The economics of its use will naturally vary from location to location, depending on conditions. In one instance it showed a total annual benefit of $64.60 per 100 ft., against $9.53 per 100 ft., representing the cost of the film and the expense of its installation at U.S. labour rates.

Controlling Botrytis

A new product, marketed by *Boots* under the trade name of 'Allisan', combats 'grey mound' or botrytis, the principal fungus disease of glass-raised lettuce. It is claimed that for the first time this disease can now be controlled without checking the growth of the plant. The product contains a nitrated chloro-aniline derivative and is sold in the form of a yellow powder which is mixed with the soil before planting or used afterwards as a dust.



Lettuce attacked by botrytis in an untreated house. Note the retarded plants, rotting plants and 'vacancies'. A close-up of the plot is seen on the left

The powder is completely odourless, taintless and non-toxic.

'Allisan' has also proved effective, under glass, against 'tulip fire', a botrytis species that reduces tulip blooms to brown tissue. The product is also a control for stem botrytis in tomatoes.

A 7-lb. tin will treat 100 sq. yd. of lettuce and the effect will persist for the life of the average glasshouse or frame winter lettuce crop.

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Tomatoes packed in bags made by Mark Anthony from 'Bexthene' film extruded from Bakelite polyethylene. These bags incorporate a form of ventilation patented by the Ventoplas Co.

Seen at the Packaging Exhibition

Polythene Liners for Bags

Mark Anthony & Sons Ltd. are manufacturers of polythene liners for jute or hessian bags to preserve the high quality of produce liable to delays in storage, transit and shipment, such as tea, coffee beans, cocoa beans or cashew nuts; it could also be used for enclosing a high-grade leaf tobacco. They also manufacture polythene liners for drums of agricultural chemicals for use where the chemical must not come in contact with the metal. Already in general use in horticulture are their plain and ventilated polythene bags, which are used as attractive fibre and produce containers.

Paper Sacks

The versatility of the multi-wall paper sack and their automatic sack-sealer was demonstrated at the Packaging Exhibition by the *Reed Paper Group*. This machine receives the filled sack, prepares the mouth and sends the container on to the sewing head. The Group were also exhibiting a comprehensive range of paper-based packaging, corrugated and fibreboard cases and a full range of special horticultural packs suitable for the transport of perishable or vulnerable products.

For Extreme Heat and Cold

Bags made of 'Spescopak' polythene film give 'eye appeal' to such products as apples, asparagus, carrots, onions, oranges, potatoes, radishes, tea, tobacco, tomatoes, turnips and watercress, and gives protection of a high order. The material is flexible and yet not easily torn, is unaffected by most solvents at ordinary temperatures, is resistant to a wide range of acids, is moistureproof and unaffected by exposure. Most important of all, it retains its flexibility and strength in the Arctic cold and Equatorial heat – so that it has a special use for prospectors, forestry workers and colonists for packing their solid and liquid rations and keeping them fresh.

Soil-sampling Bags

Chiltern Hunt Ltd. are producers of polythene bags, sheeting, piping and liners for a variety of purposes. They can be either clear or opaque, or attractively overprinted in a combination of four colours on one or both sides of the material. The plain opaque bags would appear to be most suitable for the collection of soil samples, as the surface of the bag can be overwritten with a ball point pen without perforation and provide a permanent field record.

Plastic Containers

Rigid plastic containers which will not shatter are available in a wide range of shapes and sizes and are suitable for many types of corrosive liquids or for keeping triple-distilled water used in plant nutrient trials. They are obtainable from the *Distillers Plastics Group*.

'Pliofilm' for Packing

'Pliofilm' is a transparent rubber hydrochloride film made by the *Goodyear Tyre and Rubber Co. Ltd.*, which is air-, moisture- and liquid-proof and ensures that the 'weather' inside a package is controlled. It seals *in* wanted moisture, succulence and natural flavour and it keeps *out* unwanted moisture and prevents contamination by external moulds, insects and foreign matter. It is manufactured in a range of standard gauges from 75 (.00075 in.) to 250 (.0025 in.) and the type of film varies with the amount of plasticiser used, according to the degree of moisture protection required.

The material, which is easily sealed by heat, is manufactured in widths ranging from 1 in. to 54 in. It possesses a tensile strength of 300–500 lb./sq. in. and a folding endurance of 50,000 cycles. It shows good resistance to punctures and abrasions, it generally resists oils, greases and organic solvents, but is soluble in some chlorinated solvents, esters and essential oils; it is unaffected by acids and alkalis. It possesses no toxicity and does not encourage mould growth. *Messrs. John Dickinson & Co. Ltd.* are manufacturers of bags and containers made from 'Pliofilm'.

Collapsible Plastic Containers

The new 'Vitherm' containers, produced by *Plastic Weldings Ltd.*, are made of polyvinyl chloride, a plastic which is extremely tough and waterproof. They are designed as liners for rectangular or cylindrical, wood or metal boxes and drums and, being collapsible and lightweight, can be stacked and transported easily. They are being currently used for an extraordinary variety of liquid products, such as fruit juice concentrates, essential oils, alcoholic extracts, insecticides, fertilisers, sterilisers, acids and alkalis.

World Crop Reports

Deteriorating Copra Position

INTERNATIONAL REPORT

Coconuts in 1958

In 1957 and early 1958 low rainfall in the coconut-growing regions of *Asia*, as well as in certain producing areas in *Africa* and the *Pacific*, was the main cause of lower 1958 world output of copra, following several years of expanding supplies, due principally to increased plantings. World production is estimated at 3 million tons, 10% below the volume in the previous year. The sharpest decline occurred among the main Far Eastern producers, who supply 80% of the total, while elsewhere in the world 1957 levels were barely maintained at around 600,000 tons.

In the Philippines a long period of drought ending in May 1958 resulted in a decline in output volume to 1.1 million tons in 1958, as compared with 1.3 million in 1957. At the same time, *Indonesian* output, affected by both unsettled general conditions and somewhat unfavourable weather in the previous year, was reduced to the lowest level in 10 years – an estimated 620,000 tons. Coconut crops in *Ceylon* were poor in the first half of the year, owing to drought conditions, followed by flood damage in December 1957, and higher output rates in the second half allowed only partial recovery to the normal annual volume. Weather also contributed to a further decline in *Malayan* output for the third successive year. Similar crop conditions were reported for *Thailand*, *North Borneo*, *Fiji*, *Papua* and *Tanganyika*, but in *New Guinea* and Papua as a whole, development trends maintained output at the peak level of 84,000 tons. In most African countries relatively high output levels were maintained.

Short-term prospects

In the first quarter of 1959 there was little change in the main features of the situation which developed in 1958. The crucial factors in the short-term outlook are the prospects for export supplies of copra from the Philippines and Indonesia in the second half of this year. Philippines output during the first quarter of 1959 was even lower than in the comparable period of 1958, partly due to the heavy incidence of *cadang cadang*, which has now destroyed 10 million trees in one province alone. More varied factors are operating in the Indonesian situation. The rainfall distribution which affects 1959 coconut crops was good in Borneo and Sumatra, but poor in the Celebes.

In some coconut areas production is expected to improve in 1959. A substantial increase is forecast for Ceylon, due to better 1958 rainfall and the cumulative benefits of the Replanting and Fertiliser Subsidy Schemes. In one of the major Malayan areas, Perak, production is expected to increase, but elsewhere the prospects for 1959 are again indifferent. Normal coconut crops are expected in North Borneo and some Pacific areas, and a return to the upward production trend in New Guinea and Papua is forecast as the result of better moisture conditions. The coconut crop in Thailand, as in north-east Malaya, is expected to be relatively poor.

Long-term prospects

As regards the long-term situation, the determinants of the 1958–59 position brings into greater prominence the danger of deterioration in the position of the three major exporters, the Philippines, Indonesia and Malaya. In the Philippines the gradual effect of the more rapid spread of the ' yellow mottle decline ' or *cadang cadang* disease of coconut may well slow down the rate of expansion achieved by extensive new planting from 1934 onwards, and temporary factors, such as dry weather and typhoon damage, would consequently have a more marked effect on export volume stability. Over the next decade the ravages of the disease, which is threatening the heavy tree population in the Quezon province of Luzon, may become the most important factor in the economy of the Republic.

In Indonesia no large-scale rehabilitation and planting is taking place and estimates of overall output show no upward trend. Since Indonesia's domestic requirements are continually increasing, a further decline in supplies available for export is certain. The need for a higher replanting rate and for improved yields is recognised, but some years must elapse before the results would become apparent.

Meanwhile, according to the Commonwealth Economic Committee Review of Oils and Fats, increased use is having to be made in the U.K. of whale oil for margarine manufacture. During last year 30% of the oils and fats used for this purpose was whale oil, compared with only 14% in 1956. If the foreign earnings of coconut-producing countries is to be maintained, there is obviously an urgent need for more active coconut and soil improvement programmes in almost all of them.

Mainly derived from F.A.O. Report No. 1 of 1959 'Coconut Situation'.

REGIONAL REPORTS

India

India is likely to have another bumper crop of *coffee* this year. The 1958–59 season's crop has surpassed all previous estimates, with total pool receipts to the end of June amounting to 45,398 metric tons, as against 43,670 metric tons in the comparable period last season.

The higher production is entirely due to the larger output of Robusta, which increased from 14,184 metric tons in 1957-58 to 20,227 metric tons up to June 1959.

Internal offtake during the first half of this year amounted to 14,652 metric tons, as compared with 13,557 metric tons in the corresponding period of last year. This shows that coffee is becoming increasingly popular in the country, consumption rising by 9% over a six months' period.

Indonesia

As in previous years, agriculture in the first half of 1958 was adversely affected by unfavourable weather conditions, such as excessive rains and floods, by erosion and by such pests

as caterpillars, rats and boars.

The harvested area under *paddy* showed a decrease of 2% in comparison with the corresponding period of 1957. The harvested area under *cassava*, *batatas* and *groundnuts* fell by 40%, but there was a substantial increase in the area under *maize* (43%) and *soya beans* (12%).

Copra exports dropped substantially in the period under review, compared with the same period in 1957, both in volume and value.

During the first half of 1958 estate *rubber* production totalled about 118,600 tons, as against 124,400 tons in the first half of 1957. Smallholders' rubber production has also declined.

At the end of the first half of 1958 the area under estate *sugar-cane* was 54,900 ha., while the area under smallholders' cane totalled approximately 42,000 ha. The figures for the corresponding period of 1957 were 52,900 ha. and 35,000 ha.

The production of *tea* amounted to 22,600 tons in the first half of 1958, of which 1,500 tons was produced by smallholders. Compared with the corresponding period of 1957, when production amounted to 23,400 tons, this represented a drop of 3%, which was primarily due to blister blight on the Sumatran plantations, which halved production in the first quarter of 1958.

The crop of estate *coffee* in the first half of 1958 amounted to 2,400 tons. This represented a drop of 62% compared with the same period of 1957, when production amounted to 6,300 tons. The retarded period of harvesting was accountable for this recession.

Production of *palm oil* and *palm kernels* amounted to 71,300 tons and 17,200 respectively in the same period of 1958. In comparison with the first six months of 1957, this means a fall of 4% and 5% respectively.

Output of *fibres* totalled 13,800 tons in the first half of 1958, or 23% less than in the same period of 1957.

The harvest area under estate *tobacco* in Java and Madura was, in the first half of 1958, 8% down in comparison with 1957 (from 12,000 ha. to 11,000 ha.). The area under smallholders' tobacco was also reduced from 103,000 ha. to 71,000 ha., or 31%. This recession is ascribed to the excessive rainfall during the harvest and to the delayed start of the planting season.

Yugoslavia

Yugoslavia's winter *grain* was seeded on schedule and germinated well. Virtually all the acreage intended for winter grains was seeded according to the latest report.

In the important grain area of the Vojvodina about 285,000 acres were seeded to high-yielding Italian varieties of wheat after deep ploughing and good seedbed preparation, which has proved its worth in recent seasons. Wheat fields in the Vojvodina have developed well and the stand is reported to be excellent.

Sweden

Sweden's 1959 *rapeseed* crop is preliminarily estimated at 142,000 short tons, about one-quarter more than in 1958, when a late spring materially reduced yields. Winter damage to the autumn-seeded 1959 crop was relatively slight and spring was early this year, and this normally means average yields.

The acreage under rapeseed in 1958–59 was slightly greater than the area harvested last year, but, assuming a normal winter kill of 10 to 15%, the harvested acreage this year may be slightly reduced. Sown acreage is estimated at about 215,000 acres, against 200,000 acres harvested last year.

England and Wales

The weather during July was mainly dry, sunny and warm until the 26th, with occasional local thunderstorms. Cooler weather with showers and thunderstorms then spread across all districts until the last day, which was again dry and warm.

Wheat generally was very satisfactory, although some spring-sown crops had been adversely affected by the dry conditions. On the basis of crop conditions at the end of July, the yield of wheat was expected to be 26.7 cwt. per acre, as compared with a five-year average (1954–58) of 24.8 cwt. and a yield of 24.5 cwt. in 1958. Some spring-sown *barley* was light and patchy, although autumn-sown crops looked well on the whole. The yield was expected to be 23.8 cwt. per acre, as compared with a five-year average of 23.1 cwt. and a yield of 22.8 cwt. in 1958. Many crops of *oats* were good, but some spring crops were poor due to late sowing. Crops sown on light land had been adversely affected by the drought and were below average in several areas. The yield of oats was forecast at 20.7 cwt. per acre, as compared with a five-year average of 19.9 cwt. and a yield of 19.8 cwt. in 1958. *Mixed corn* was satisfactory except where drought checked growth, and was expected to yield 21 cwt. per acre, as compared with a five-year average of 19.8 cwt. and a yield of 19.6 cwt. in 1958. *Rye* was expected to yield 18.9 cwt. per acre, as compared with a five-year average of 19.4 cwt. and a yield of 19.4 cwt. in 1958. *Beans for stockfeeding* were fairly satisfactory, but damage by black fly was reported from many areas. The yield was forecast at 16.5 cwt. per acre, as compared with a five-year average of 17.2 cwt. and a yield of 16.1 cwt. in 1958. *Peas for stockfeeding* were a satisfactory crop. The yield was expected to be 15 cwt. per acre, as compared with a five-year average of 12.4 cwt. and a yield of 9.6 cwt. in 1958.

Conditions for lifting first early *potatoes* were favourable and the tubers were of good quality. Reports indicate that some crops were light owing to the previous dry conditions and the yield was expected to be 5.4 tons per acre, as compared with a five-year average of 5.6 tons and a yield of 5.7 tons in 1958. Second early and maincrop varieties, which had been retarded by the dry weather, were improving and on the whole were fairly satisfactory. The yield per acre was expected to be slightly below average.

All *root crops* and *kale* had been adversely affected by the dry conditions. Crops of *sugar-beet* generally were fairly satisfactory; aphis attacks were severe, but the incidence of virus yellows was slight; the yield per acre of roots was expected to be a little below average. Many *mangold* crops were healthy, but others were patchy and suffered from aphis attacks; the yield per acre was expected to be below average. *Turnips and swedes* germinated unevenly and were making slow growth; the yield per acre was expected to be below average. Early-sown crops of *kale* were fairly good on the whole, but late-sown crops germinated badly and were backward.

Acknowledgment is made to *For. Crops Mark.* and to *Spec. Reg. Inform. Services* for much of the information contained in the above reports.